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# GYNECOLOGY

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With 388 Half-Tone and Pen Drawings by
The Author
And 146 Microscopic Drawings by
Margaret Concree and Ruth Huestis
With 103 of the Illustrations in Colors

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TEACHER AND FRIEND

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# PREFACE TO THE THIRD EDITION

In the third edition of this book it has seemed advisable to preserve the original arrangement of subjects and to make such revisions as will bring the material thoroughly up to date. To accomplish this purpose more than two hundred changes have been made in the text and illustrations in the way of additions, omissions, and corrections. Of these changes the most extensive have been made in the subject of Ovarian Tumors, in the etiology and pathology of which much new knowledge has been acquired. The epochal work of Dr. John A. Sampson on the Perforating Hemorrhagic Cysts of the Ovary has been included, and is of such far-reaching importance in the general pathology of the female pelvis that it has necessitated many changes in the text throughout the book. A number of newer operations that have stood the test of experience have been added. These are, for the most part, in the line of plastic surgery and are introduced in order to give the student as wide a choice as possible in following the work of the best modern operators. Many additions and substitutions have been made in the drawings from microscopic sections, with the hope of keeping before the student's mind the extreme importance of becoming familiar with the special phases of gynecologic pathology.

William P. Graves.

Boston, Mass.,
*October*, 1923.

# PREFACE

This work is designed both as a text-book and general reference book of Gynecology. In order to meet these two requirements a special classification has been adopted dividing the subject matter into three distinct parts:

Part I deals with the physiology of the pelvic organs and with the relationship of gynecology to the general organism. The latter subject is a comparatively new departure, and is presented in conformity with the latest methods of medical teaching which strive to impress on the student's mind the importance of the correlation of all branches of medicine and surgery. It is hoped that this part of the work will prove of value both to the advanced special student and to the general practitioner who includes gynecologic patients in his clientele.

Part II is designed primarily for the undergraduate student who is taking his initial course in gynecology. It includes a description of those diseases which are essentially gynecologic, and is thus isolated in a somewhat compact form in order that the student may not be confronted by a too formidable array of facts in his collateral reading and in his preparation for his final examination in the subject. In order to accomplish this purpose certain encumbering details have been subordinated. Thus, in the description of each disease, the underlying pathologic processes are enumerated. Microscopic detail, however, can better be learned from pictures than from tedious descriptions. For that reason drawings from microscopic sections illustrating the respective diseases are presented under each subject with full descriptive legends appended to them. In like manner the surgical principles involved in the treatment of the various diseases are recounted, but the technic of the operations and the pictures illustrating their performance, matters of secondary interest to the student of the theory of gynecology, are reserved for a separate section.

Part III is devoted exclusively to the technic of gynecologic surgery and is written for the assistance of the advanced student and practitioner. Surgical devices for the cure of gynecologic diseases are innumerable, and it is impossible to include them all in a book of this scope. Only those operations which from the personal experience or judgment of the author seem best suited for the special requirements are presented. Many excellent procedures have, therefore, been unavoidably omitted.

In preparing a work of this kind material must be gathered not only from the author's personal experience, but to a still greater extent from the work of others. Out of a great number of authorities consulted there have been several to which I have had such frequent recourse, both for new material and for cor-

roboration of personal observations, that I must make a general acknowledgment of indebtedness to them. In writing the sections on the relationship of gynecology to the general organism I have received the greatest assistance from the monumental work entitled "Die Erkrankungen des Weiblichen Genitales in Beziehung zur inneren Medizin," published by Prof. Frankl-Hochwart as a supplement to Nothnagel's "Pathologie und Therapie." In writing Part II the authorities to which I owe most are the great "Handbuch" of Veit, the "Handbuch" of Opitz and Menge, the "Lehrbuch" of Küstner, and the various works of Dr. Howard A. Kelly and his associates.

In making the half-tone drawings I owe much to the instruction of Mr. Max Brödel, who many years ago showed me the technic which he has developed and which has been universally imitated, but never equalled, in the field of medical illustration. To Miss H. J. Ewin, Superintendent of the Brookline Free Hospital for Women, I am indebted for the accumulation and tabulation of a vast number of statistics gathered from hospital records and patients' letters. On the basis of these statistics I have been able to draw many valuable conclusions. To my associate, Dr. F. A. Pemberton, belongs the credit of selecting the pathologic sections and of supervising the microscopic drawings, most of which have been executed by Miss Margaret Concree.

Several of the illustrations have been published previously in an article by the author in the American Practice of Surgery.

William P. Graves.

Boston, Mass.

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# GYNECOLOGY

## PART I

## PHYSIOLOGY AND RELATIONSHIP OF GYNECOLOGY TO THE GENERAL ORGANISM

### Physiology of the Uterus and Ovaries

#### THE UTERUS

During the first decade of life the female genitalia play a very unimportant physiologic rôle. In the last months of intra-uterine life there is a somewhat rapid development of the uterus, and at birth is often seen a discharge which appears like true menstrual blood. The uterus then for several months undergoes a process of regression, from which period there is a very slow growth until the time of puberty.

The hypertrophic changes in the uterus just before and after birth are at present supposed to be due to the action of hormones from the placenta, which influence the development of the maternal uterus and that of the child, both of which undergo involution when the stimulus of the placenta is removed (Halban).

At birth the uterus is high in the pelvis and pressed backward by the intestines which lie in the uterovesical space. At this time it is pointing upward and its axis is practically straight. During the first ten years of life it sinks gradually deeper in the pelvis, and acquires the angulation between body and cervix known as anteflexion. There is also a tendency to sag backward toward the sacrum into the position of retrocession. The persistence of this position after maturity constitutes the typical condition of local infantilism.

The growth of the inner genitalia during the first ten years is comparatively slight, but toward the age of puberty there is a very marked and rapid development. The uterus does not usually attain its full growth in the virgin until several years after puberty.

Child-bearing increases the size and weight of the uterus, so that it measures on an average 1 cm. more in each dimension than does the virgin uterus and weighs about 20 gm. more. The length of the virgin uterus is 7 to 8 cm., and its weight from 40 to 50 gm. During lactation the uterus undergoes a temporary atrophy due to a shrinking, but not a loss of the muscle-fibers, and normally regains its proper size after lactation ceases. At the menopause the uterus

becomes permanently atrophied as a result of a diminution both in size and amount of muscle tissue.

The ovaries of the child during the first ten years also show an insignificant growth. The infantile ovary is narrow and slender. Toward puberty there is a rapid development, and the organ assumes a rounder, more oval contour. The dimensions of the mature ovary are 3 to 5 cm. long, 2 to 3 cm. wide, and 1 to $1\frac{1}{2}$ cm. thick.

In the fetus the tube is twisted into tight convolutions, which straighten out somewhat toward the end of intra-uterine life, especially near the isthmus. As the child grows older the tube gradually becomes straighter, so that at puberty there are only moderate convolutions. After child-bearing the tube becomes nearly straight. The twisting of the tube sometimes persists after maturity, and is regarded as one of the stigmata of infantilism. It is thought to be one of the causes of sterility and of tubal pregnancy.

At puberty the secondary sexual characteristics become more pronounced and differentiated from those of the male. Most important of these are the development of the breasts, relative width of the hips, slenderness of the waist, length of the hair of the head, small bony structure, general undulating contour of the body, and absence of body hair, except in the axillæ and on the pubes.

The breasts at the time of birth, both in boys and girls, are enlarged, and, like the female uterus, undergo retrogression in the first few weeks. It is thought that this enlargement of the breasts at birth is due to the influence of the placenta, to which is also ascribed the growth of the maternal breasts during pregnancy. The rapid mammary development at puberty and the temporary enlargement during menstruation is probably referable to the influence of the ovarian inner secretion (Halban-Schröder).

Woman reaches her highest period of development and her greatest fertility about the middle of the third decade of life.

**Physiology of Menstruation.**—Menstruation is probably established at the time of the first complete ripening of an ovum. The first appearance of blood usually takes place at about the fourteenth year, though in some it begins as early as eleven and in others as late as sixteen. These may be regarded as the normal limits. Precocious menstruation in infants is usually due to some disturbance in the glands of internal secretion, while late menstruation (*i. e.*, after sixteen) is commonly the result of some ovarian deficiency, either primary in the ovaries themselves or secondary to the influence of other glands of internal secretion.

There are, however, numerous factors which influence the establishment of the menses; one of these is climate. Climate apparently affects the period of puberty somewhat, but not to the extent formerly supposed. It is commonly stated that in tropical regions menstruation begins usually from eight to nine, while in the colder regions it is much later than the general average. Engleman has, however, shown in extensive statistics that this is an error, and that the

average age of puberty is very nearly the same in the tropics and in the arctic zones—namely, about fourteen and one-half years. In the Polar regions women are said to menstruate from two to four times a year, as a rule, and not at all during the winter months. Heredity plays a certain rôle, as do general racial characteristics, but the variations from these causes are not wide. Social conditions also make some difference, for statistics show that the poor begin to menstruate later on an average than the well-to-do and reach the menopause earlier. This is thought to be due to hard work and poor nourishment. It has also been observed that those who live in the country come to puberty later than those who live in the city, probably for the same general reasons. It must be remembered that these figures have been compiled from European countries, where social conditions differ from those in this country. Statistics on this subject in America are scanty.

The duration of menstrual life is usually between thirty and thirty-five years. Kniger's table is as follows:

| | |
|---|---|
| Menopause at 36–40 | 12 per cent. |
| Menopause at 41–45 | 26 " " |
| Menopause at 46–50 | 41 " " |
| Menopause at 51–55 | 15 " " |
| Menopause before 35 and after 55 | .7 " " |

As a rule, those in whom puberty comes early have the menopause somewhat later than the normal. Women of this type tend to menstruate more profusely and have a special predisposition to myoma formation, which of itself prolongs menstrual life.

Nulliparous women and virgins reach the climacteric somewhat sooner than do parous women.

Women of the upper classes menstruate distinctly later than women of the poorer classes, the menopause of the former averaging nearer fifty than forty-five. Undoubtedly better nourishment and freedom from hard work explain this fact.

It is usually stated that the menopause appears earlier in hot climates than it does in cold. Statistics on this point are conflicting. It is probable that climate has no very decided influence on the menopause, but that in those countries where it appears abnormally early it is affected chiefly by the very early child-bearing to which the women are subjected and by which they prematurely lose their bloom.

When the function of menstruation is established it is apt to be irregular at first, but when fully instituted the typical intermenstrual period is from twenty-seven to thirty-one days. There seems to be a special type of women who menstruate every twenty-three days. This type is usually of the class who begin early and have a late climacteric. It is probable that in most women who menstruate every twenty-one to twenty-three days there is some underlying pathologic condition.

In healthy women the average length of the menses is three to four days. These limits may fluctuate somewhat and still be regarded as normal. In general, however, women who menstruate only one or two days, and those who flow more than five days are not to be regarded as entirely within physiologic limits.

The amount of blood lost at each menstruation has been variously estimated by different investigators. It probably averages about 50 gm. in the unmarried and somewhat more in the married and parous (Hoppe-Seilet).

Menstrual blood is more watery and paler than normal blood, and is mixed with detritus and the secretions of the uterus, cervix, and vagina.

The most important characteristic of the menstrual blood is its non-coagulability. This was formerly supposed to be due to the influence of the alkaline cervical mucus, on the ground that blood when alkaline is less coagulable than when acid. The cervical mucus, however, is probably not accountable for the phenomenon. Birnbaum and Osten have shown that the body blood of a menstruating woman is only one-half as coagulable as it is when she is not menstruating, but this has recently been denied. The change was thought to be due to some agent which affects the entire organism of the woman, and was referred to the influence of the ovarian secretion. It is now supposed to be due to a local influence of the ovarian secretion exerted on the endometrium.

During menstruation there is marked congestion of all the pelvic blood-vessels, and as a result the uterus is larger and softer and more compressible. The tubes and ovaries are also swollen. The external genitals exhibit a decided hyperemia. The breasts are somewhat fuller and often tender and painful, and in some there is a noticeable enlargement of the thyroid gland.

A few women experience a special sense of well-being during the menstrual period, but in most women there is a general physical and mental depression which is manifested in many different ways. The nervous equilibrium especially is unstable. There is increased irritability and susceptibility to psychic excitement. All neurotic tendencies are accentuated and often appear at this time only. Headaches periodically associated with some particular time of the menstrual period are very common. (See also section on Neurology.)

The majority of women have some form of pelvic discomfort during catamenia. Under physiologic conditions this may be merely a sense of heaviness or pelvic pressure. If there is actual pain, the condition is one of dysmenorrhea (*q. v.*).

The symptoms of any pathologic process, especially of the lower abdomen, like appendicitis or salpingitis, are exaggerated by the menstrual congestion.

Practically, all of the functions of the body may share in the general depression and exhibit symptoms more or less disturbing. In the digestive system there may be loss of appetite, tendency to vomiting and formation of gas in the intestines, increased mucus from the colon, and constipation or diarrhea.

The circulatory system may show irregular pulse and palpation of the heart. Various vasomotor disturbances are frequent, such as hot flushes, cold extremities, sweating, etc. The mucous membrane of the nose and throat is often swollen, causing mouth-breathing. Nose-bleeds are frequent. The vocal chords become swollen, so that there is a change in the voice. Singers experience a change in the quality and trueness of their notes, and often are obliged to refrain from singing in public during the menstrual period. The hearing is apt to be less acute, while the eyes, too, may suffer from granulation of the lids, lessening of the field of vision, and impairment of color sense. Various skin manifestations are common during the menstrual period, examples of which are exanthematous rashes, herpes of the lips, urticaria, acne, etc.

The sexual impulse is, as a rule, increased just before and just after the catamenial flow. It is usually decreased during the period, but may be increased. Some patients suffer pain and discomfort about half-way between their periods, resembling that which they have at their regular flow. This intermenstrual pain is usually due to some pathologic process, most commonly an intramural fibroid. In other cases it cannot be explained by any anatomic lesion.

*Precocious menstruation* relates to the appearance of the menses in infants of two to four years old, associated with abnormal development of the breasts and external genitals, growth of pubic hair, and awakening of the sexual impulse, usually shown by masturbation. This condition is the result of abnormalities in the glands of internal secretion, and is referred to in detail in the section on the Internal Secretory Organs.

*Vicarious menstruation* is a phenomenon about which little is known but which undoubtedly occurs at times. Instead of the regular menstrual flow, bleeding takes place more or less periodically from some other organ of the body, usually the nose. Other sites of vicarious bleeding described are the lips, breasts, lungs, rectum, hemorrhoids, ulcerations, and wounds. Vicarious menstruation from the nose is sometimes seen after hysterectomy operations, where an ovary has been left *in situ* or where a piece of it has been transplanted.[1]

The menses may be influenced to some extent by psychic excitement, especially that due to fright or anxiety. In women who menstruate normally the flow after having started may be suppressed by a sudden nervous shock, or such a shock may bring on the menses out of the regular time. It is a common experience in a gynecologic clinic that women whose periods are usually regular menstruate out of time under the mental excitement of waiting for operation. Menstruation is often delayed for several days and even a week in women who are laboring under the fear of impregnation, and also in women who, being extremely anxious to become pregnant, have their minds tensely concentrated on the function.

[1] Sippel (Munch. Med. Wchnschr., 1921) denies the existence of a true vicarious menstruation. He asserts that the true phenomenon is due to the effect of increased blood-pressure on the circulation of an organ previously damaged.

The question of performing pelvic operations during the menstrual period is one of some importance and one concerning which there is difference of opinion. Some operators make it a rule never to operate at this time, while others pay little attention to the matter. It is probable that in the majority of instances patients operated on during the catamenia have a normal convalescence, but occasionally it happens that a constitutional effect is produced by the operation that results in alarming symptoms. These appear within thirty-six or forty-eight hours after the operation and simulate closely the condition of profound shock. Patients in this state have had their abdomens reopened in the belief that they were suffering from a secondary internal hemorrhage. The condition lasts for several hours and then passes away. No entirely satisfactory explanation has been made of this phenomenon.

The effects of menstruation on the general organism mentioned above are treated in greater detail in other sections.

**The Climacteric.**—The menopause is usually a slow change extending over several months to several years. Menstruation in rare instances ceases abruptly; more commonly there is a gradual cessation, consisting either of a progressive diminution in the amount of flow or in a lengthening of the intermenstrual period. Many women before the end of the menopause exhibit a greater profuseness in the flow and shorter intermenstrual periods. An increase of blood during the menopause is not to be regarded as physiologic, a misconception which often leads to grave errors. The most common pathologic causes of menorrhagia at the menopause are cancer, fibroids, and polyps. In many cases, however, no definite anatomic changes can be discovered, and the bleeding must be referred to an insufficiency of contractile power on the part of the uterine musculature. This uterine insufficiency is not normal or physiologic, for it subjects the patient to a period of semi-invalidism which may last over several years.

When the menopause is established all the genital organs undergo a process of atrophy, which in extent varies greatly in different women. (For a detailed description of Genital Atrophy, see page 575.)

Many women pass through the menopause with little or no trouble and this may be considered the norm. There are, however, certain constitutional and psychic disturbances of a quasiphysiologic nature which perhaps the majority of women experience to a greater or less extent. These may occur only at the time of the actual menopause, but they may make their appearance several years before any change takes place in the function of menstruation and may last long after it has ceased.

The most typical of these disturbances are hot flushes, palpitation, buzzing in the ears, dizzy feelings, nervous irritability, tendency to depression, various forms of neuroses, and often serious psychoses. It is a common belief also that certain physical changes take place, such as a deepening of the voice, appearance of hair on the upper lip and chin, accumulation of fat, and a general coarsen-

ing of feature and contour. This last so-called reversion to the masculine type has been greatly exaggerated. Women who have a tendency to obesity begin to grow fat long before the menopause, as a rule, while those who eventually develop coarseness of feature show this characteristic as soon as the bloom of youth begins to pass. The appearance of hair on the face in middle age is not a universal attribute, but only an individual peculiarity, and is merely evidence of advancing age. Women of innate physical refinement often show a greater delicacy of lineaments as they approach and pass the climacteric.

The vasomotor and psychic disturbances referred to above are thought to be the result of the loss of ovarian secretion. Doubtless the atrophy of the ovaries does account for some of these manifestations, especially those of the vasomotor type, but this influence has also been greatly exaggerated. Severe manifestations of this kind nearly always appear in individuals with well-marked neurotic predisposition, while women of the well-balanced type usually suffer little. As Walthard has pointed out, the so-called critical period of a woman's life comes at a time when domestic responsibilities and worries are at their height, while the consciousness of approaching old age and the loss of physical attractiveness constitutes a most important factor in the discontent and mental despondency that women of middle age, especially of the social classes, are wont to exhibit.

Just before the climacteric there is usually an increase of the sexual impulse. This may last for a considerable time, but, as a rule, it gradually diminishes.

After the age of fifty or thereabouts women often undergo a complete change in temperament. Relieved of the anxieties of child-raising, and reconciled to the changes of age, they acquire a mental and physical strength never before experienced, and live for a decade or two the best years of their life.

**Physiology of Conception.**—During coitus there takes place a hypersecretion of the glands of the vestibule and of Bartholin's glands, the evident purpose of which is for lubricating the parts. The semen is deposited in the posterior vault of the vagina, which is termed the receptaculum seminis, into which under normal conditions the cervix dips. It was formerly supposed that the semen was received directly into the cervical canal, but this cannot be so, as the cervix normally points at right angles to the axis of the vagina. Another proof that the semen does not enter directly into the cervix is the fact that in retroversion or anteflexion, where the cervix points in the direction of the canal, and in a more favorable position for receiving the semen, conception usually does not take place.

From the receptaculum seminis the spermatozoön reaches the cervical canal chiefly by its own power of locomotion, but it is undoubtedly assisted by the cervix and its mucous secretion. During orgasm the cervical glands pour forth strings of mucus from their ducts, which, dipping into the pool of semen, act as channels for the passage of the spermatozoa into the canal. It has been claimed that the cervix during orgasm undergoes certain muscular movements

which serve to aspirate the semen into the lumen. The normal alkaline reaction of the cervical mucus undoubtedly also plays an important part in the process, for spermatozoa soon die in the acid medium of the vaginal secretions. The chief factor for motion in the upward progress of the spermatozoön is unquestionably its own motility. As proof of this is the occasional conception that takes place where the cervix has been amputated, in which there is little question of cervical secretion or aspirating movements. That the spermatozoön is capable of weathering a journey through acid secretions the length of the vagina is shown by the not infrequent cases of conception where there has been no introition.

It is now well accepted that the union of the spermatozoön and ovum takes place either at the fimbriated end of the tube or on the surface of the ovary. The union of the two germ-cells (amphimixis) is consummated by the success of one spermatozoön in piercing the surrounding envelope of the egg. Only the head which contains the nucleus of the male germ-cell enters the ovum, the tail breaking off. On the entrance of the spermatozoön the envelope of the ovum immediately becomes thickened, preventing penetration by other aspirants. The impregnated ovum is then guided by the fimbriæ of the tube to the canal where it is swept on to the uterus, partly by the current of the cilia of the surface epithelium and partly by peristaltic motions of the tubal wall. The passage of the ovum to the uterine canal occupies several days to possibly a week. During this time it acquires the power of corrosion, which is characteristic of fetal tissue, and when it reaches the uterine canal it digs a bed for itself in the endometrium where it proceeds to develop, nourished as a parasite by the mother's blood. If the passage into the uterine canal is in any way interrupted the egg sinks into the mucous membrane of the tube and produces an ectopic pregnancy.

Orgasm on the part of the woman is not necessary to conception, although its absence is often associated with sterility, especially in cases of hypoplasia. That orgasm and libido are not essential factors in conception is proved by the frequency with which frigid women become mothers, and by the recorded instances of impregnation during narcosis.

**Physiologic Anatomy of the Menstruating Endometrium.**—That the uterine mucosa passes through definite cyclic changes each month is a comparatively recent addition to our knowledge, due chiefly to the researches of Hitschmann and Adler, who rediscovered facts that had already been announced years before.

The cycle of change is divided into three phases: (1) Premenstrual congestion, (2) period of menstruation, and (3) postmenstrual involution.

The *premenstrual congestion* begins about ten days before the expected period. By this process there is a marked thickening of the mucosa, due to an hypertrophy and hyperplasia of the endometrial glands and a transudation and exudation into the stroma. The mucosa becomes two or three times thicker

FIG. 1.—PREMENSTRUAL ENDOMETRIUM.

Low power. At the bottom is the muscle of the uterine wall, sharply demarcated from the endometrium. The glands in the deepest part of the endometrium are small, their epithelial cells low, for this part of the gland remains inactive. The stroma cells are small and lie close together. At the middle of the endometrium the glands are dilated, the epithelium wavy, and the epithelial cells swollen and actively secreting mucus. The stroma cells are larger and lie further apart. On the right the dilatation of the blood-vessels is well shown. Near the top the glands have the same characteristic as at the middle, but there is more edema of the stroma. Throughout there is a slight infiltration with round cells.

than the normal, and may reach 6 to 7 mm. in depth. The surface becomes irregular and furrowed as a result of the general swelling beneath. At this stage the endometrium resembles closely an early decidua vera. The stroma cells are large, pale and swollen, and separated by the edematous exudate. The mucosa is distinguished by two fairly well-defined layers, the deeper containing the dilated and hypertrophied glands, termed the *spongy layer*, and

Fig. 2.—Premenstrual Endometrium.

High power. This drawing shows the enlargement of the nuclei of the epithelial cells, which, instead of being small and lying at the bottom as in inactive glands, have enlarged and nearly fill the cells. The cells crowd each other and a papilla can be seen in the central gland.

the outer, denser, and less glandular portion, called the *compact* layer. The dilated blood-vessels (seen chiefly between the spongy and compact layers) are surcharged with blood. By diapedesis and by actual rupture (rhexis) blood is poured into the stroma of the mucosa, and by following the line of least resistance toward the surface forms subepithelial hematomas. It is probable that at this point uterine contractions force the blood through the surface of the mucosa into the uterine canal, marking the second phase of the cycle, the

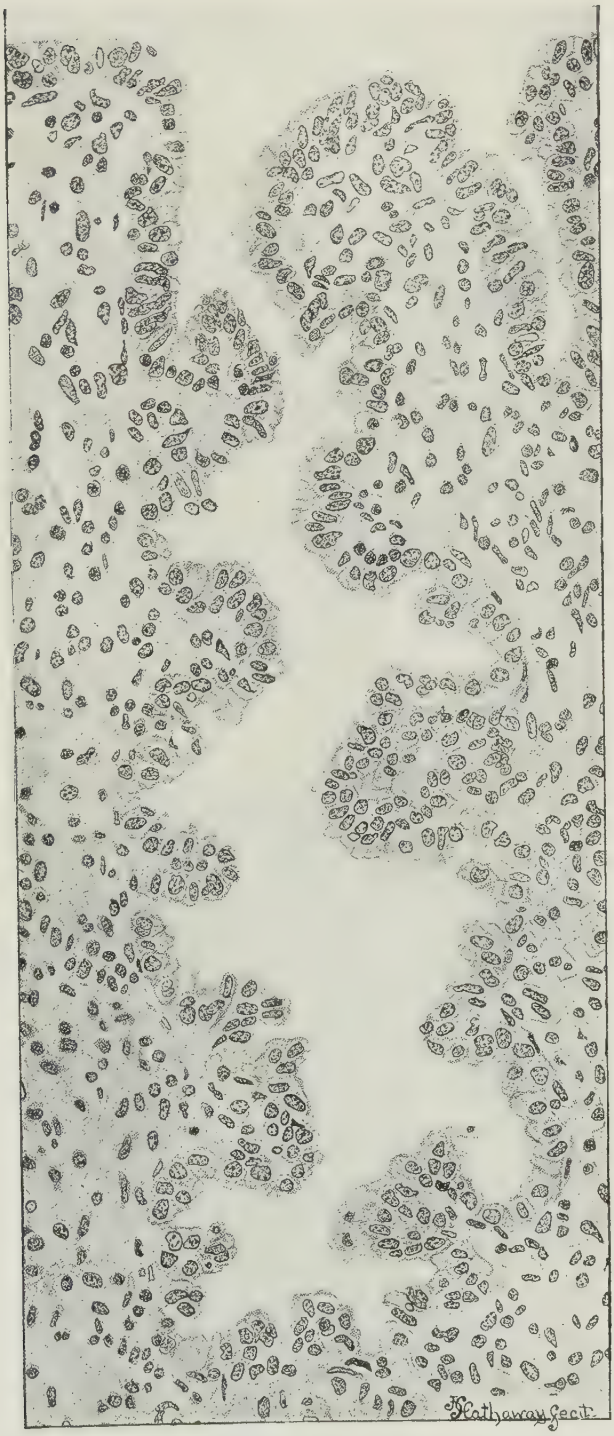


FIG. 3.—PREMENSTRUAL ENDOMETRIUM.

High power of part of a gland. This shows especially well how the epithelium of the glands is thrown out in tuft-like projections during this stage. The lower part of the gland is dilated, while the neck near the surface is narrow, holding the secretion in the gland.

menstrual flow. The blood escapes into the lumen, partly through the interstices between the epithelial cells and partly by actual rupture of the cell layers, small clumps of which may be desquamated and discharged mixed with the menstrual blood.

Fig. 4.—Premenstrual Endometrium.

High power. The glands are dilated and several show invaginations of epithelium, the beginning of one of which is seen in the lower left-hand corner. The epithelial cells are swollen, the nuclei large and nearly filling the cells. The stroma cells are swollen and lie far apart, due to edema. A dilated blood-vessel is seen in the upper right corner. A few round cells are scattered through the tissue.

With the cessation of the bleeding begins a regeneration of the mucosa. The secretion becomes clearer and finally disappears. The mucosa returns to its previous thickness of 2 or 3 mm. The blood-vessels shrink to their normal size, and the extravasated blood in the stroma gradually becomes absorbed, leaving for a time small brownish pigmented spots. The broken surface epi-

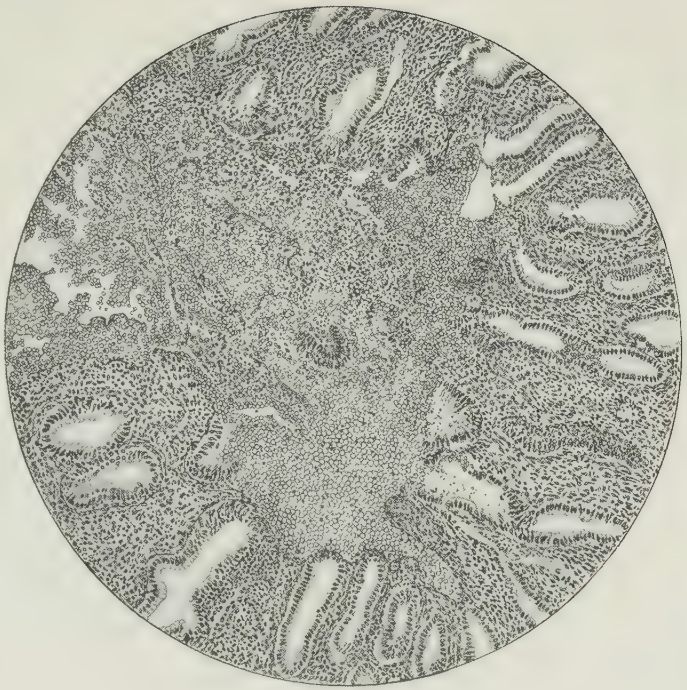

FIG. 5.—MENSTRUATING ENDOMETRIUM.

Low power. The glands throughout have discharged their contents and collapsed. The epithelial cells are still swollen. The stroma is very edematous and infiltrated with blood, especially on the left. At the bottom the glands are still somewhat dilated, but there is very little edema of the stroma.

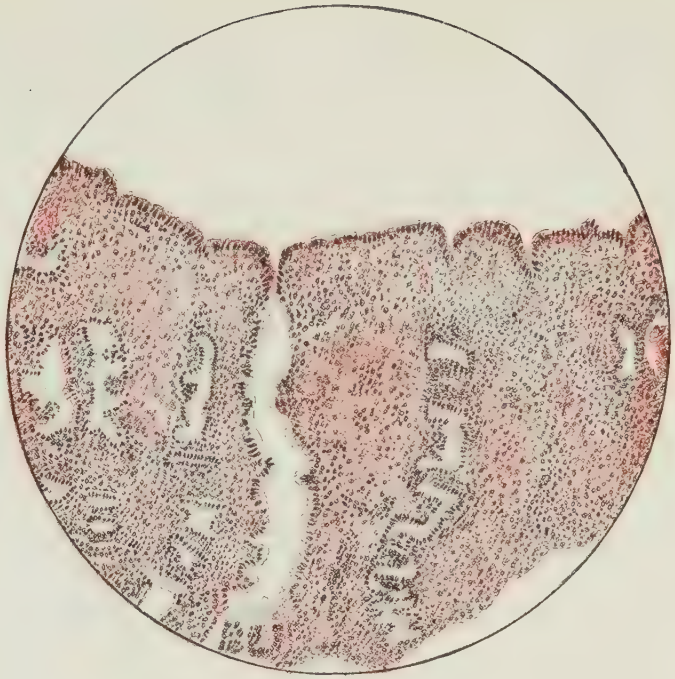

FIG. 6.—ENDOMETRIUM AT BEGINNING OF MENSTRUATION.

The glands, except for the one seen in the center, have collapsed, having discharged the material which was secreted during the premenstrual stage. The blood-vessels have been eroded by the ferment contained in the secretion, allowing the blood to exude into the tissue and on the surface of the endometrium. The surface epithelium in this section is still intact.

thelial layer becomes regenerated by the growth of new cells. The hypertrophied glands, which during the premenstrual stage became lengthened, spiral-shaped, and distended with secretion, discharge their contents during the period of menstrual flow and then resume their original small narrow form and straight direction. When the bleeding has ceased the edema of the stoma disappears and the pale swollen stroma cells regain their former appearance.

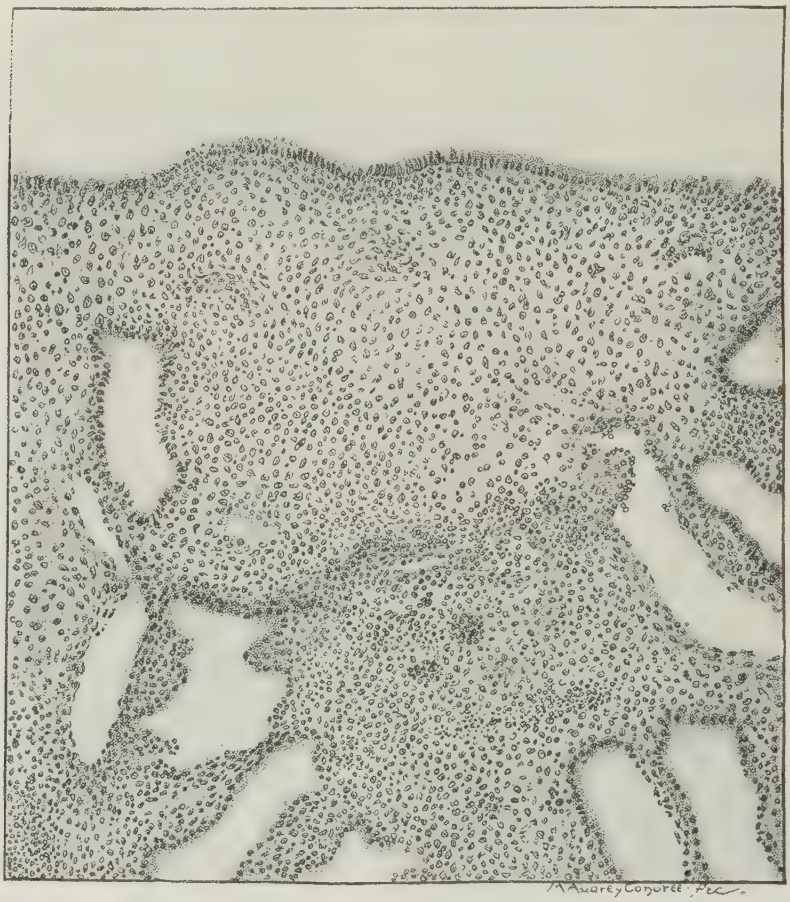

Fig. 7.—Postmenstrual Endometrium.

Low power. The surface epithelium is regenerated. The glands are still dilated, but the epithelium is low, the nuclei of the cells small and lying at the bases. There is some edema of the stroma near the top, but the cells are smaller, the blood-vessels collapsed. There is a slight infiltration with round cells and blood-corpuscles.

The postmenstrual regenerative stage lasts about fourteen days, when the rhythmical changes in the mucosa begin anew.

If no menstruation takes place, or, in other words, if conception has occurred, the premenstrual mucosa maintains its character and merges into a true decidua.

It has been shown that during the cyclical change there is an increasing

glycogen production from the mucosa, which reaches its height during the menstrual flow, after which it disappears, until the premenstrual stage begins again. This glycogen production is undoubtedly a provision for the nourishment of the egg.

FIG. 8.—SECTION OF NORMAL CERVIX.

Note the high columnar mucous epithelium. In the right and upper parts of the section are seen many smooth muscle-fibers in cross-section. At the lower right are several smooth muscle-cells drawn in detail under high power.

During the period of flow the superficial epithelial cells of the mucosa are said to lose their cilia. These are restored during the postmenstrual regenerative stage.

The cervical mucous membrane takes no part in the menstrual bleeding,

but secretes an increased amount of mucus. There is a question as to whether the tubal mucous membrane shares in the bleeding. It probably does not, as a rule, but there is evidence from abdominal operations done during the menstrual period, where the tube can be inspected, that there is sometimes an associated tubal menstruation.

The researches of Hitschmann and Adler have been questioned to some extent, but in the main they are now nearly universally accepted.

## PHYSIOLOGIC ANATOMY OF THE OVARY[1]

In our present knowledge of gynecologic physiology the ovary has assumed such a commanding position that it is necessary to devote special attention to its functional anatomy.

The ovary is covered by a single layer of low cuboidal cells, called the germinal epithelium, which unites with the peritoneal endothelium in an irregular line at the hilum. *This germinal epithelium is embryologically continuous with the epithelium of the tubal and uterine mucosa.* Though modified and apparently insignificant in its rôle as a covering of the ovary, it nevertheless has extraordinary potentialities for growth, and is probably the chief factor in the etiology of parenchymatous ovarian cysts.

During childhood the surface of the ovary is for the most part smooth, but after puberty the scarring process of ovulation gives it an irregular furrowed appearance. Under the germinal epithelium is a thin, rather dense layer of fibrous tissue, which gives the ovary its whitish appearance and which is called the albuginea. This structure is not fully developed until the time of puberty, and at that time consists of three layers of connective tissue. In old age and certain pathologic conditions it becomes much thickened, and if abnormally thick may play a part in the causation of sterility.

Beneath the albuginea is the parenchymatous layer, which consists of a characteristic cellular connective tissue in which are contained the follicles. Merging into the parenchymatous layer is the medullary layer at the hilum, through which pass the blood- and lymph-vessels, nerves and connective tissue, and muscle-fibers from the broad ligament. In this layer are found small glandular ducts, which are by some thought to be the remains of the Wolffian ducts and are supposed to connect with the parovarium. A more recent theory is that they are off-shoots from the germinal epithelium.

The follicles are confined exclusively to the parenchymatous layer. It is estimated that at birth the individual is endowed with about 30,000 of these follicles, and it is generally accepted at the present time that no new ones are created after birth. The essential function of the ovary consists in the development and ripening of the follicles. This process begins very early, probably at the end of intra-uterine life. Up to the age of puberty the ripening

[1] Chief authority, Schroder in Opitz and Menge.

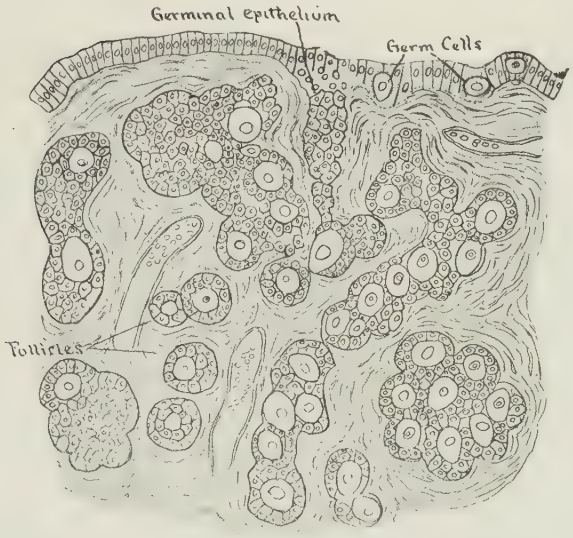


FIG. 9.—FORMATION OF FOLLICLES, FROM THE OVARY OF A NEWBORN INFANT.

Germ-cells can be seen in the outer germinal layer of epithelium. The germinal epithelium can be seen growing inward and eventually surrounding the germ-cells by a single layer of cells. (After Küstner.)

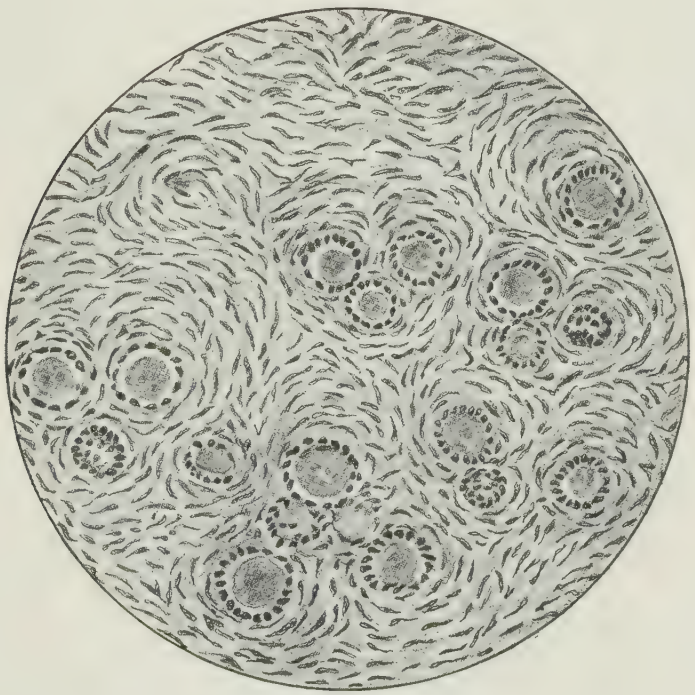

FIG. 10. —PRIMORDIAL FOLLICLES FROM THE OVARY OF A WOMAN OF TWENTY-FIVE.

The central protoplasmic mass is the germ-cell or egg. It is enveloped by a single layer of epithelium. (After Veit.)

follicles become atretic or aborted, and only at that time do they begin to develop into true corpora lutea. From puberty there is a continuous process of development of the follicles until the menopause, when they disappear entirely.

In the maturing process there are three stages to be distinguished: (1) the primordial follicle, (2) the ripening follicle, and (3) the ripe Graafian follicle.

(1) The *primordial follicle* lies embedded in the stroma of the ovary, immediately under the albuginea. It consists of the naked egg surrounded by a

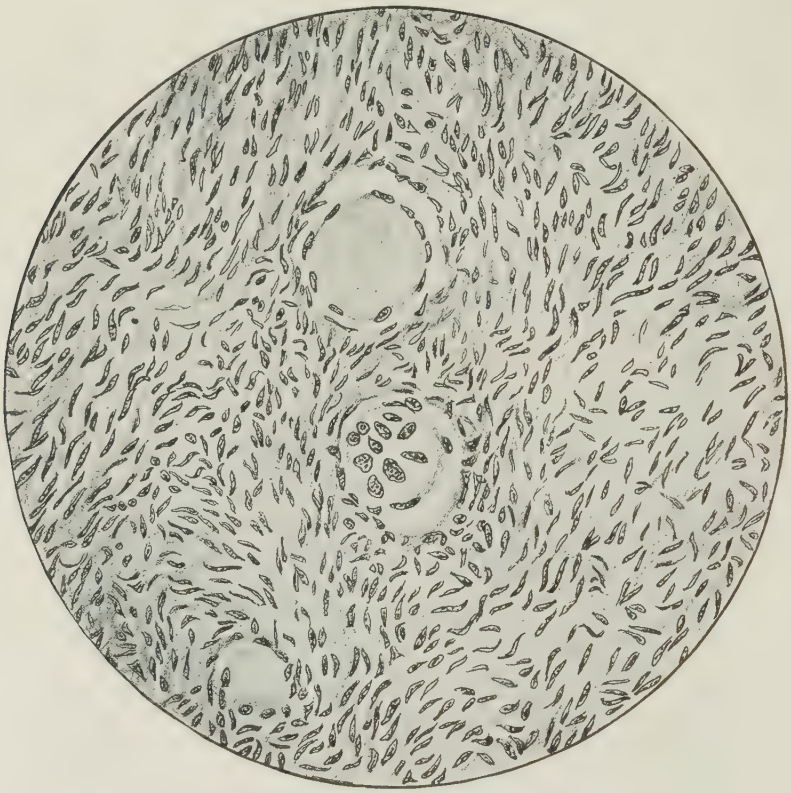

Fig. 11.—Graafian Follicle.

High power. Three follicles are seen which are in the earliest stages. The center one has begun to show proliferation of the cells. These cells were originally derived from the germinal epithelium covering the ovary. No ova are seen.

single layer of low flat epithelium. The primordial egg is an ellipsoid, membraneless cell fairly constant in size. The cell-body is composed of a clear protoplasm in which can be distinguished a very fine network. In the center of the body is a round nucleus with a definite surrounding membrane. The nucleus contains an eccentrically lying nucleolus, which is not always observable in the fetus and newborn, its absence showing probably an immature stage of development. The epithelial layer of the follicle has been shown to be derived from the germinal epithelium which surrounds the ovary, and, as will be seen,

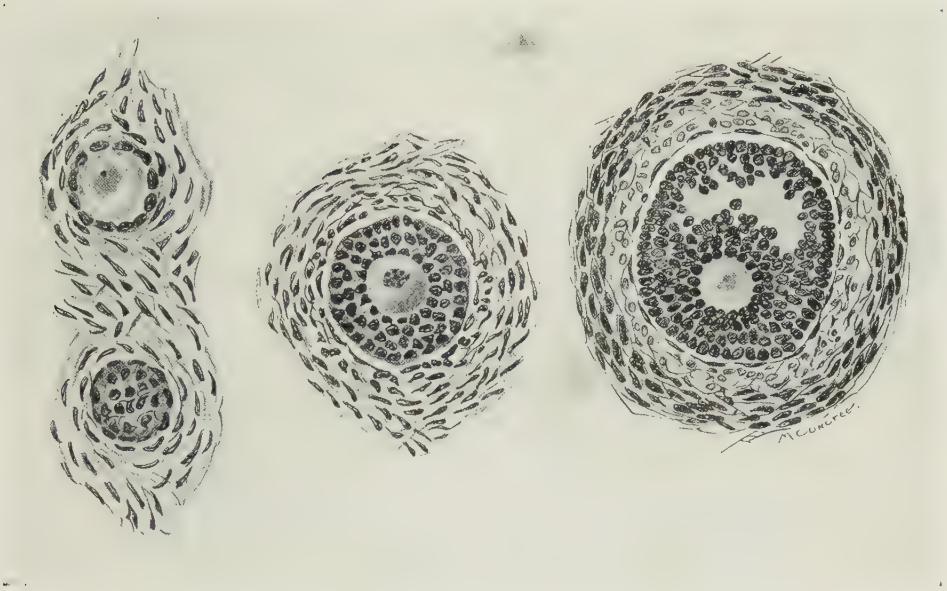

FIG. 12.—EARLY DEVELOPMENT OF THE FOLLICLE.

On the left are two primordial follicles, the upper showing the egg and surrounding follicle epithelium; the lower showing the manner in which the follicle epithelium completely surrounds the egg. The middle picture shows the earliest stage of ripening in which the follicle epithelium multiplies into several layers. The third picture shows a further development of the follicle epithelium and the beginning of the crescentic clear space containing the liquor folliculi. (After Bumm.)

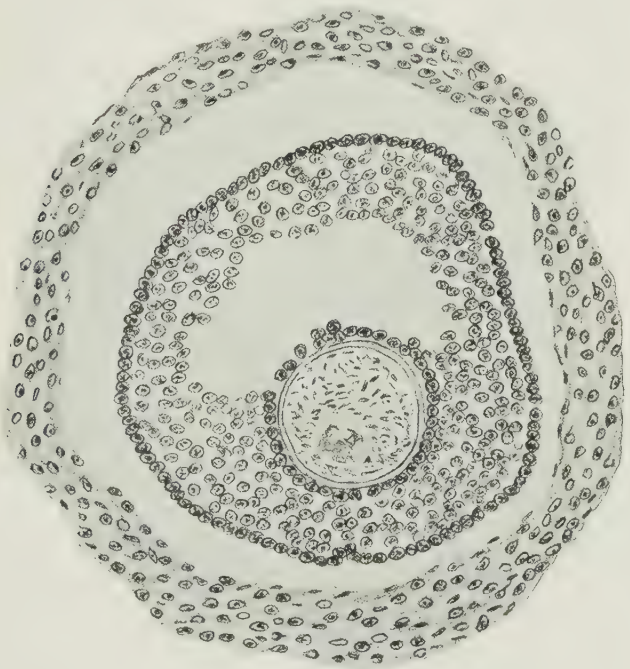

FIG. 13.—GRAAFIAN FOLLICLE FROM THE OVARY OF A NEWBORN INFANT.

The clear space around the layer of epithelium is the result of an artefact in preparing the section. (After von Winckel.)

is a structure of much importance. The fundamental function of the ovary represents a repeated ripening of the primordial follicles. They can be seen in lessening numbers up to the time when ovulation ceases at the menopause.

(2) *The Ripening Follicle.*—When the follicle begins to ripen the surrounding epithelial cells begin to multiply by mitosis and to heap up into several layers. The cells now assume a larger and more cuboidal form and lie closely around the egg. Soon in this mass of cells there appears a vacuolization, or clear space, which becomes filled with fluid, the so-called liquor folliculi. The

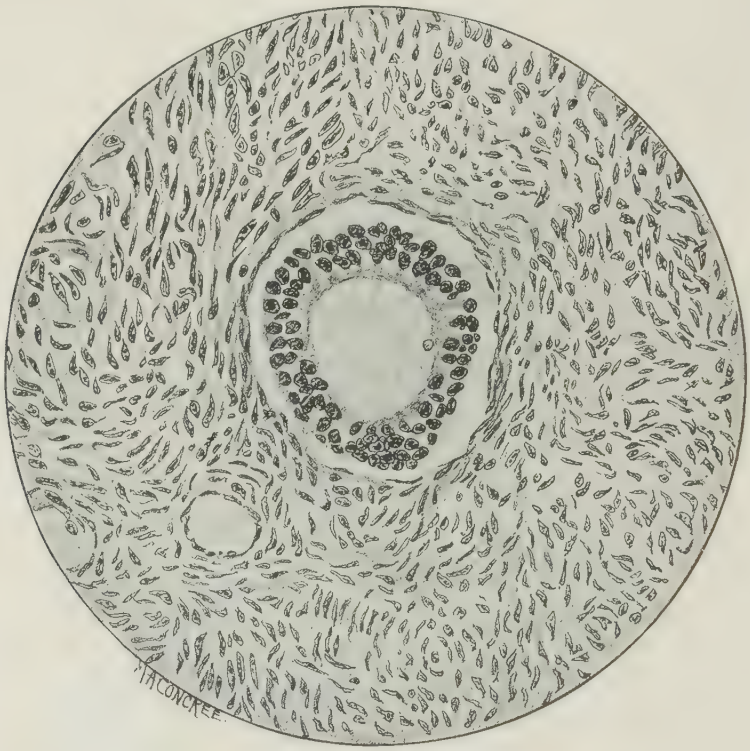

Fig. 14.—Graafian Follicle.

High power. In the center of the drawing is a follicle undergoing development. In the center of the follicle is the ovum, which is surrounded by layers of cells constituting the membrana granulosa. The theca folliculi is not differentiated as yet. To the lower left side are two primordial follicles.

clear place containing the liquid is crescentic in form, partly encompassing the egg. Several layers of epithelial cells continue to envelop the egg, and the mass thus formed juts out into the liquor like a peninsula. The collection of protecting cells that surround the egg is called the *discus proligerus* (or cumulus oöphorus), while the rest of the epithelium around the periphery of the follicle is called the *membrana granulosa.*

At the same time that these changes are going on inside the follicle, it is being surrounded on the outside by a concentric envelope of connective tissue, termed the *theca folliculi.* This envelope is plainly divided into two layers,

that lying farthest away from the follicle being termed the *tunica* or *theca externa*, and that lying next to the follicle being called the *tunica* or *theca interna*. The tunica externa is thick and dense and consists of circularly arranged connective-tissue fibers. It contains the blood- and lymph-vessels that supply the follicle. The tunica interna is also composed of connective tissue, but is much more cellular than the externa. These cells are large and rich in protoplasm and are epithelioid in character. Toward the end of the ripening stage they are actually larger than the epithelial cells of the membrana granulosa.

Meanwhile the egg also undergoes a change. It becomes surrounded by a strong homogeneous capsule, the *zona pellucida*. The protoplasm of the egg

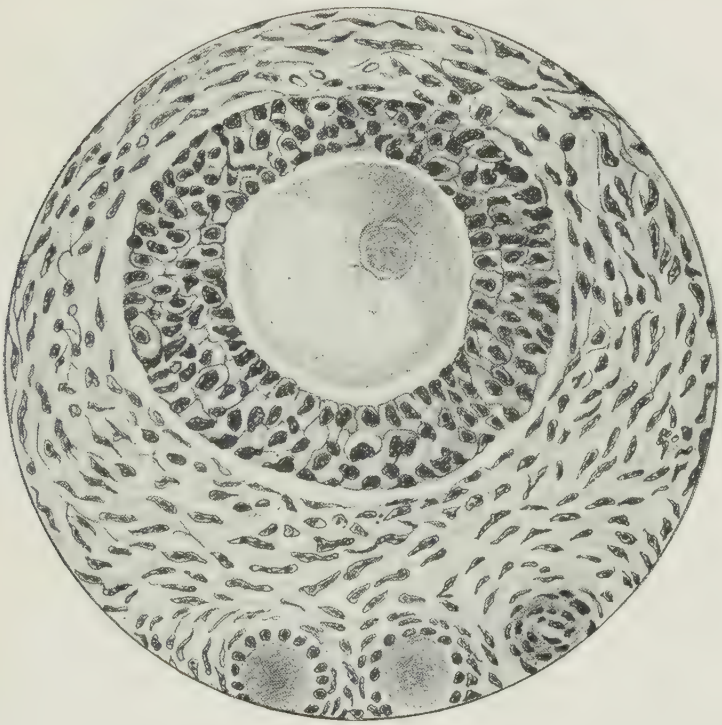

Fig. 15.—Ripening Follicle from an Ovary of a Woman of Twenty. (After Veit.)

does not come in direct contact with the zona pellucida, there being between the two the so-called perivitelline space, which contains fluid and in which the egg enjoys a free movement. As the follicle develops the crescentic lake containing the liquor folliculi becomes more and more filled with fluid, which forms from a transudation of the vessels of the theca and from vacuolization of the granulosa cells. It is a thin serous fluid containing albumin and is undoubtedly a source of nourishment for the egg. The egg surrounded as it is by several radiating layers of granulosa cells (the discus proligerus) does not come in direct contact with this fluid, but evidently receives nourishment from it through the

medium of a fine intercellular network (paladinos), the fibrils of which reach the zona pellucida.

The follicle as it grows larger recedes from the albuginea, and lies more deeply embedded than do the primordial follicles.

When the changes described above are completed the follicle is said to be ripe, and at this stage it is termed a Graafian follicle. Up to the time of the menopause follicles in all stages of development, from the primordial to the ripened form, may be seen in the ovarian parenchyma. In all the follicles, even

Fig. 16. —Graafian Follicle.

Surrounding the follicle can be seen the two connective-tissue envelopes, the outer (theca externa) being fibrous in character and the inner (theca interna) being more cellular. The egg is seen jutting out into the clear space surrounded by a mass of epithelial cells, the discus (or cumulus) proligerus. The several layers of epithelium lining the follicle constitute the membrana granulosa. The crescentic clear space is filled with serous fluid, the liquor folliculi. (After Veit.)

the smallest, numerous nerve-fibers accompany and surround the capillary vessels, extending to the follicle epithelium and existing in small nodes in the membrana granulosa of the larger follicles.

In some of the follicles can be seen two and, rarely, three eggs. This appearance is usually seen in the unripe follicles. It is not known whether this appearance represents twin eggs from the start, or whether it signifies a merging of two primordial follicles or a division of one follicle.

(3) *The Graafian Follicle.*—When the follicle is ripe it moves slowly toward the surface and thins out the outer layer of the ovary. This pressure on the

surface of the ovary creates a pale translucent spot, called the *stigma*, through which the egg is finally discharged.

The internal force which serves to burst the follicle is a subject of some debate. It is usually explained as follows: With the energetic development of the vessels of the tunica externa there is a corresponding increase in the size and number of the cells of the tunica interna, which force themselves toward the center of the follicle and gradually push the proligerus with its egg toward the

FIG. 17.—GRAAFIAN FOLLICLE AS IT APPEARS IN THE SURROUNDING OVARIAN TISSUE. Just below the follicle is a corpus albicans.

stigma. The internal force is also enhanced by the gradual increase in the amount of liquor in the follicle, especially during the menstrual congestion.

*Corpus Luteum.*—When the follicle has ruptured and the egg discharged the formation of the corpus luteum begins. The center of the collapsed follicle soon fills with blood, which issues partly from the vessels of the theca and partly from the small wound in the stigma. In animals this blood coagulum is not always seen, but it is practically constant in the human corpus luteum.

Around the central blood-mass is the wrinkled yellow membrane which characterizes the corpus luteum by its unique color. There has been some

question as to the origin of the cells that make up the yellow membrane, but it is now generally accepted that they represent the hypertrophied epithelial cells of the membrana granulosa. They are large and polymorphous, with a large nucleus, and resemble somewhat decidual cells. The cell-body contains drops of fat and yellow pigment granules that give the characteristic color. These are the so-called lutein cells. Into this lutein layer sprout blood-vessels and connective-tissue radial projections, which vascularize and support the

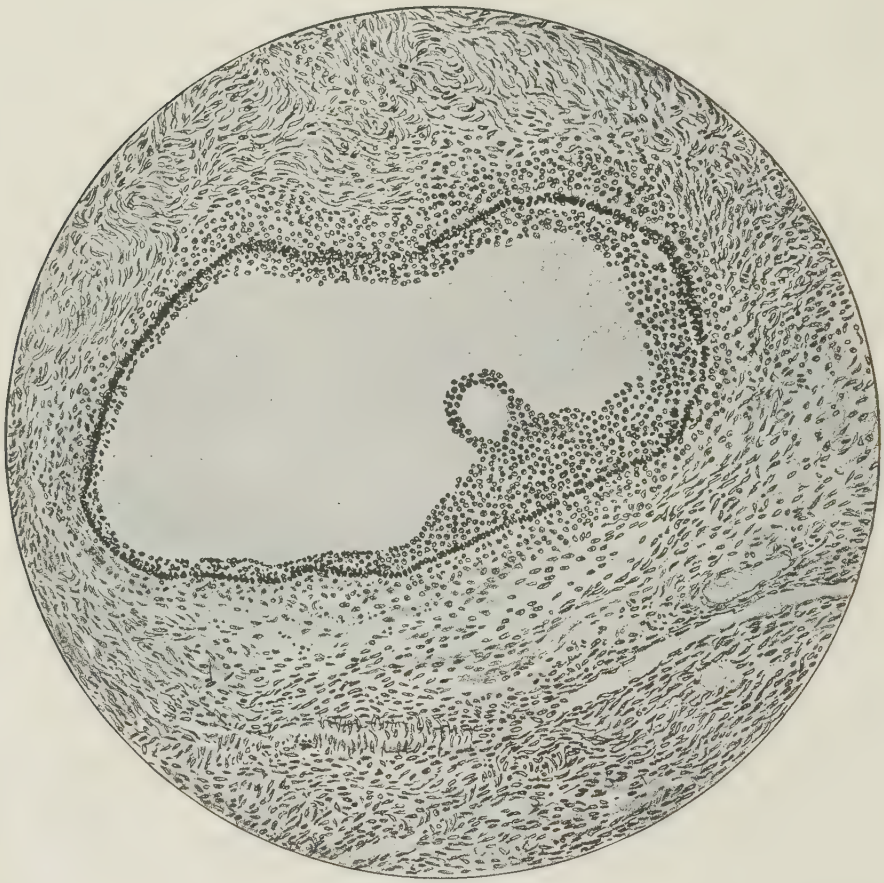

Fig. 18.—Graafian Follicle, Well Advanced.

corpus luteum. The resultant picture of large epithelial cells, with pale staining nuclei lying in contact with small thin-walled blood-vessels, corresponds to the structural appearance commonly regarded as characteristic of organs of internal secretion. As will be seen, this is one of the arguments for the belief that the seat of the internal secretion of the ovary is in the corpus luteum.

After the corpus luteum reaches the height of its development it gradually shrinks. The yellow coloring matter is absorbed and the lutein cells degen-

erate in hyalin masses, held together by strands of connective tissue. The hyalin colorless masses then roll together in cloud-like convolutions and form the corpus albicans. This process of regression occupies about four weeks. The corpus albicans may remain a long time, but the hyalin material is eventually entirely absorbed and all trace of the former corpus luteum disappears, excepting the scarred indentation on the surface of the ovary.

The size of the corpus luteum varies considerably, reaching sometimes even in non-pregnant women a diameter of 2 cm. If pregnancy occurs its develop-

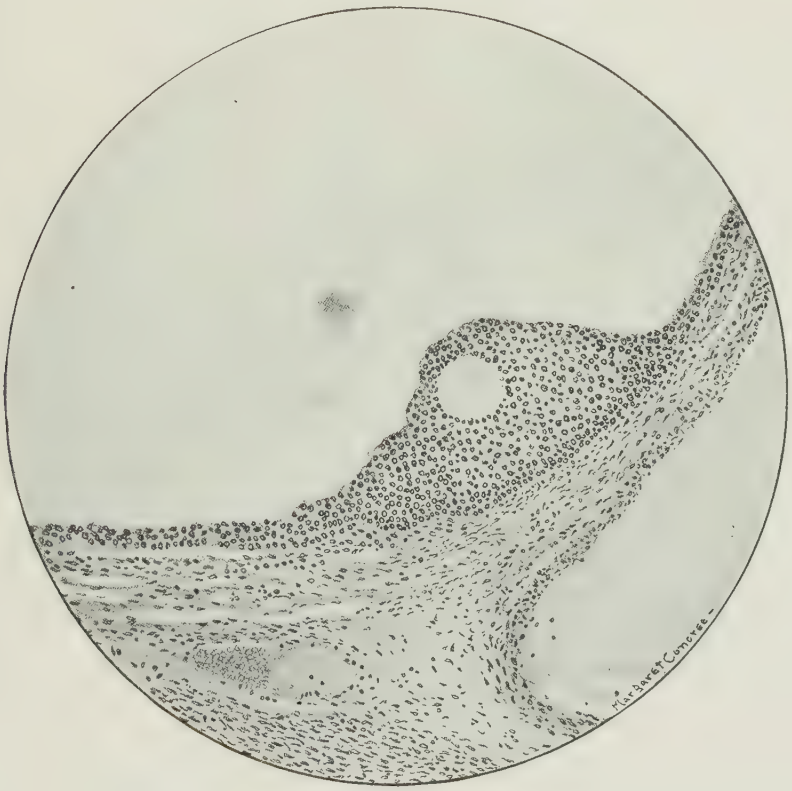

FIG. 19.—GRAAFIAN FOLLICLE.

Low power. This shows the edge of a fully developed follicle. The upper left part of the drawing is the cavity in the follicle. At the lower right edge projecting into this cavity is the cumulus proligerus, consisting of cells from the membrana granulosa, which lines the cavity, in the center of which is the ovum. At the bottom of the drawing can be seen a small section of ovarian stroma. Between this and the follicle is the connective tissue of the theca folliculi.

ment is more pronounced, reaching its height about the second month. From the third month its regression is very slow, so that it is sometimes demonstrable at the end of pregnancy.

If pregnancy is not present, the corpus luteum regresses rapidly and is usually shrunken by the end of a month.

*Follicle Atresia.*—In the thirty to thirty-five years of menstrual life about fourteen to eighteen follicles reach full maturity each year, making a total of

400 to 600 during a lifetime. Inasmuch as there is an original endowment of about 30,000 follicles at birth, only a small percentage of them develop completely, the remainder becoming aborted during some stage of their development, a process that is called *atresia of the follicle*. This process must be regarded as a physiologic one, beginning as it does in the newborn and probably in the mature fetus and lasting until the menopause.

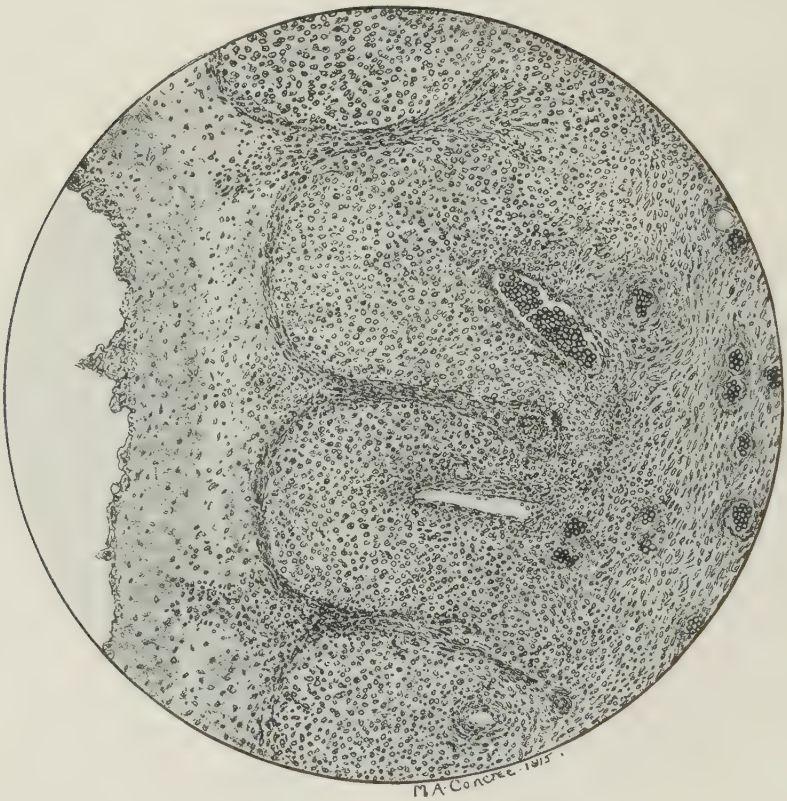


FIG. 20.—CORPUS LUTEUM.

Low power. At the top is the center of the corpus luteum, the edge seen being the edge of the blood-clot. Extending into this blood-clot are seen the pyramids formed of lutein cells, giving the edge of a corpus luteum its characteristic ruffled appearance. Between these two layers is a thin layer of connective tissue. Below the layer of lutein cells—that is, around the outside of the corpus luteum—is the theca externa, which contains many blood-vessels.

The cause of atresia is thought to be some insufficiency of the local blood-supply, or a too deep embedding, which may be unfavorable for the bursting of the follicle.

Follicle atresia takes place in the following way:

The egg slowly undergoes a fatty degeneration and becomes liquefied. The granulosa cells also degenerate by the process of vacuolization and fall into the central cavity of the follicle. The entire follicle collapses and assumes an irregular contour. At this stage the cells of the tunica interna begin to grow

and assume an epithelioid type, resembling closely the lutein cells of the membrana granulosa. This theca membrane may become quite thick and wavy, like that of the granulosa. As in the true corpus luteum there is a vascularization and connective-tissue formation, so that the resulting picture is the same as that of the corpus luteum, the essential difference being that the lutein cells *are of connective-tissue origin, and not epithelial.*

Follicle atresia is especially marked during pregnancy. During this period there is no actual ovulation, so that most of the more mature follicles become atretic.

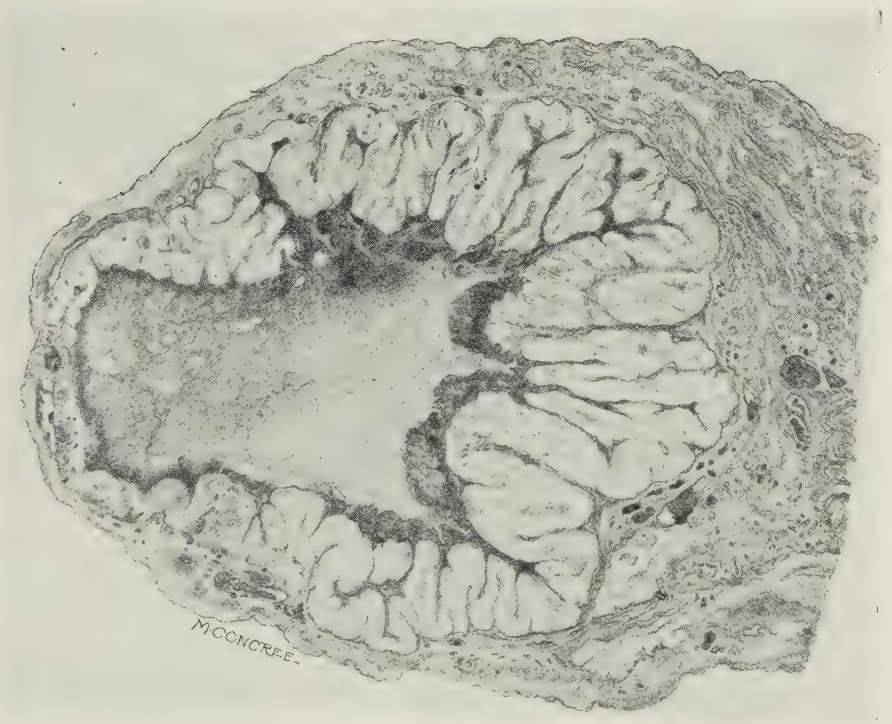


Fig. 21.—Corpus Luteum.
Around the edge is the plicated envelope of lutein cells.

It is said that during pregnancy there takes place in the theca lutein cells of the atretic follicles not only hypertrophy but hyperplasia, and that the cells acquire more fat and lutein than is seen in the non-pregnant state. In chorio-epithelioma and tubal gestation they sometimes form definite cysts which later disappear.

In some species of animals the collections of theca lutein cells embedded in the stroma form a constant picture. These masses of cells have been called the interstitial gland, and correspond, as said above, to the lutein cells of the atretic follicles. They are thought by some to play a part in the manufacture of the internal secretion of the ovary.

Two forms of follicle atresia are distinguished—the obliterating and the cystic. Cystic formation in the ovaries is, therefore, physiologic. The cysts,

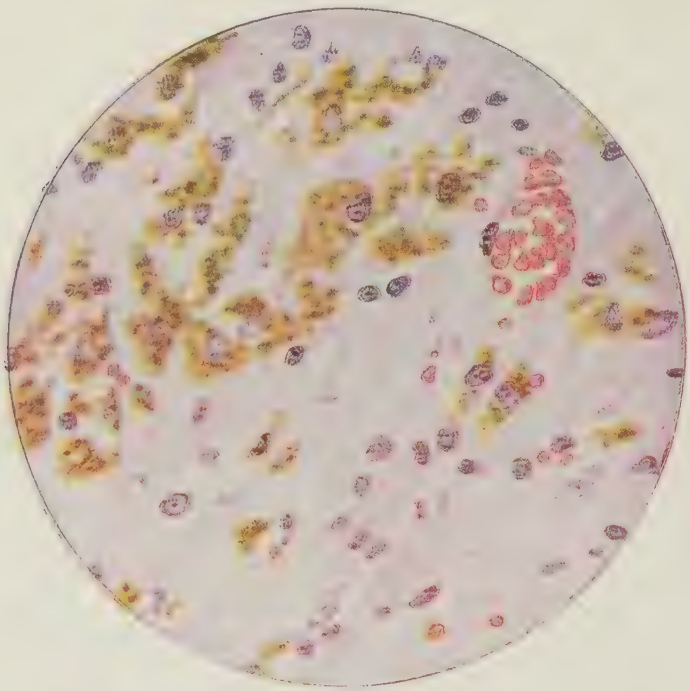

Fig. 22. —Wall of Corpus Luteum.

High power. This shows the pigment found in the lutein cells. which gives them their distinctive yellow color. It is derived from the blood extravasated during rupture of the follicle.

however, may grow to an abnormal size and become of pathologic significance. (See Retention Cysts.)

# Relationship of Gynecology to the General Organism

## Relationship of Gynecology to the Glands of Internal Secretion

The study of the internal secretory organs has assumed so great an importance that a familiarity with the subject is essential in the study of every branch of medical science. This is eminently true of the department of gynecology, for the female organism is peculiarly susceptible to physiologic and pathologic changes in the general endocrine system. Much of our knowledge gleaned from the vast store of experimental and clinical observation in this new line of research is so contradictory and confusing that space will not permit a comprehensive review of the subject. It will be necessary, therefore, to devote our attention chiefly to those facts that are most convincing and most generally accepted, with especial reference to the phases of the subject which relate particularly to the generative system.

The essential glands of internal secretion may be defined as ductless structures which by the agency of certain cellular elements manufacture chemical substances, called hormones, that are absorbed directly into the blood-circulation and by this means are enabled to influence the functions of other organs.

The term *internal secretion* is necessarily used in a somewhat restricted sense. Broadly speaking, each tissue of the body by means of its specific chemical secretions is capable of affecting through the blood-stream other parts of the body. In this sense the entire organism may be regarded as forming a complex internal secretory system. The subject, however, is confined to the consideration of a series of organs which produce hormones with especially powerful and important physiologic characteristics. This series of organs constitutes the ductless glandular system and comprises the thyroid apparatus, the thymus gland, the suprarenal system, the hypophysis cerebri or pituitary body, the epiphysis or pineal body, the generative glands, the pancreas, and a few other organs, such as the kidneys, the intestinal and gastric mucosa. To this list the placenta has recently been added.

Although by the internal secretory theory the influence of distant organs on each other is based on a chemical reaction instead of, as was formerly believed, on a direct nervous relationship, the nervous system nevertheless plays an important part, for many of the phenomena produced by the internal secretions are brought about by chemical action on the sympathetic or vegetative system of nerves. The glands of internal secretion are themselves supplied by sympathetic nerves and their function is, therefore, in large part regulated by the nervous system. The intimate relationship between the ductless glands and the sympathetic nerves is especially significant from a gynecologic standpoint on account

of the peculiarly sensitive and labile character of the female nervous organization. It is known, for example, that the generative organs exercise a particular influence on the tone of the vegetative organs (*i. e.*, organs that are supplied by sympathetic nerves), an influence which is more marked in women than in men. This is most noticeable at the so-called critical periods of a woman's life. At the menstrual period and during pregnancy there takes place an increased excitability of all the vegetative functions, which may be manifested either by an accentuated vitality or by various deviations from the normal. During the climacteric, when the generative glands cease their function, the influence of the internal secretions on the vegetative system makes itself apparent by temporary vasomotor disturbances of a most varied character. At the time of puberty there takes place a most important increase in the vegetative functions, the change being more marked in girls than in boys. In all these instances the influence on the sympathetic system is due not alone to the internal secretion of the generative glands, but in part to the correlated action of the other ductless organs.

The theory of a correlation between the glands that constitute the endocrine system though only vaguely understood is, nevertheless, essentially well established. It may be stated in general that the ductless glands are normally so correlated as to form a perfect physiologic balance which is preserved by a proper distribution of harmony and antagonism between the functions of the various glands. If one of the glands is diseased or injured or extirpated the normal balance is upset and the organism of the individual may be affected by the abnormal action of one or more distant glands of the group. The reciprocal disturbance created in a given gland by the abnormality of another member of the system is often referred to as dysfunction. Such *dysfunction* probably does not constitute an alteration in the chemical composition of the secretion of the gland in question, but rather implies a change in the amount, that is to say, a diminution or an accentuation of the secreted substance. Changes in glandular activity of this kind are also referred to as *hypo-* and *hyper*functional. The reciprocal action of the different ductless glands and of their various secreting parts during a given upset of balance is of an exceedingly complex nature, and in our present state of knowledge is only partially understood.

It was first thought that an internal secretion could only be elaborated by epithelial elements. The histologic type of internal secretory structure was described as consisting of relatively large, pale, not sharply defined epithelial tissue containing a rich network of capillary blood-vessels which carry off into the circulation products of the cell activity. This description is applicable to certain of the internal secretory tissues, but it has been discovered that structures of connective-tissue origin are also capable of manufacturing an internal secretion, and that in one and the same organ epithelial and connective-tissue elements may be working side by side, each elaborating secretions destined for separate purposes. Examples of this are seen in the hypophysis, the suprarenals, and the ovaries.

## OVARY[1]

That the ovary is a true organ of internal secretion is proved by very substantial evidence gained from observations made after removal, and from transplantation of ovarian tissue, and by the effects of the injection into the tissues of ovarian substance. Castration before sexual maturity causes a failure of genital development, while in adult life it produces immediate regressive changes in the uterus, vagina, and external genitals, manifested by well-marked atrophy of the parts. It has been shown by animal experimentation (Halban) that this genital atrophy can be inhibited after castration by transplanting the extirpated ovary in distant parts of the body, and if this operation is done on young animals the other genitals may develop normally. It has also been shown in animals that castration prevents rut, but that later implantation of ovarian tissue may reproduce the manifestations of rut (Halban).

An observation of much practical importance (as we shall see later) shows that the injection of ovarin in virgin animals creates changes of hyperemia and secretion in the internal and external genitals similar to those which occur during rut.

These are only a few examples of numerous experiments that prove the existence of an ovarian internal secretion.

The exact nature of the ovarian secretion has not been determined, nor is it conclusively known in what part of the ovarian tissue the substance is manufactured. It seems probable that different portions of the ovary elaborate substances which have specific functions. There are two anatomic structures which may most reasonably be expected to be sources of hormones—the corpus luteum and the follicle apparatus.

Inasmuch as ovarian secretion is known to exist before puberty, as proved by the changes in development after castration before maturity, it seems likely that the follicle apparatus must be the seat of manufacture, for the corpus luteum does not appear normally until sexual maturity. It is probable, therefore, that the follicle apparatus presides over the growth and nutrition of the genitals and that it influences directly or indirectly the general bodily development of the individual. The true nature and extent of the influence of the growing follicles are not known. Theories as to the internal secretory power of the atretic follicles are given below.

In addition to the follicle apparatus, the corpus luteum has been shown to be the probable seat of manufacture of important ovarian secretion. As has been described in detail (see page 39), the corpus luteum forms within the follicle cavity after the discharge of the ovum, and is derived from the epithelial (granulosa) cells lining the follicle. In its full development the corpus luteum presents the characteristic picture of an internal secretory gland, with large pale cells lying in close proximity to thin-walled blood-vessels, an appearance

[1] Some of the material in this section is taken from articles by the author published in the American Journal of Obstetrics, 1913, and in the Journal of the American Medical Association, 1917.

much like that of the adrenals. The corpus luteum does not develop until the age of puberty, and coincident with its appearance come the cyclical changes of menstruation and the possibility of fecundation, phenomena which disappear after the cessation of corpus luteum formation at the climateric.

That the corpus luteum is an organ of internal secretion was first suggested by Gustav Born, who, after studying the corpus luteum verum of pregnancy, expressed the opinion that in histologic structure it corresponds to an internal secretory organ, and that it probably presides over the implantation and development of the fertilized egg in the uterus. Fraenkel supported the theory of Born by experimental work and attributed new physiologic functions to the corpus luteum; namely, the increase of the uterus at the time of puberty as well as its cyclical hyperemic changes of menstruation. Fraenkel concluded that the effect of the internal secretions of the corpus luteum is a preparation of the uterus for the insertion and development of the fertilized egg, menstruation taking place in case of failure of impregnation. Notwithstanding considerable opposition to many of Fraenkel's views, it is at present almost universally accepted that the corpus luteum is an organ of internal secretion, though the knowledge of its specific action is incomplete.

Recent work by Leo Loëb has added valuable information regarding the corpus luteum as an organ of internal secretion. He has confirmed by experiments the theory that the corpus luteum inhibits ovulation, and has shown experimentally that ovulation may be accelerated by the removal of the corpus luteum. The absence of ovulation during pregnancy is thus thought to be due to the continued presence of the corpus luteum. Loëb's most important contribution has been to demonstrate by animal experimentation the power of growth which the corpus luteum has over the uterus. He has shown that the corpus luteum elaborates a substance which has a sensitizing action on the uterus. In the non-pregnant animal a slight decidual reaction is produced in the uterine mucosa which recedes in a short time as the corpus luteum retrogresses. In the pregnant animal the decidual reaction is much more marked and remains permanent during pregnancy in the form of the so-called maternal placenta (*i. e.*, decidua). This continued reaction is the result of the persistence of the corpus luteum and to the irritation of the growing ovum, as is proved by Loëb's experiments. If the uterus of a non-pregnant animal is incised or the mucosa mechanically irritated at the time during which the corpus luteum is elaborating its "growth substance" a very marked decidual reaction is produced in the uterine mucosa, forming what Loëb terms a deciduoma or maternal placenta. Such deciduomata are short lived in the non-pregnant animal.

Decidual reaction (*q. v.*) is therefore undoubtedly dependent on the internal secretion manufactured by the corpus luteum. In guinea-pigs and in rabbits this reaction is producible only in the stroma of the uterine mucosa. In these animals extra-uterine pregnancy experimentally created does not cause a decidual reaction in the stroma of surrounding tissues as is seen in the human female

(see Ectopic Pregnancy). Loëb suggests, with good reason, "that the difference in the readiness with which extra-uterine pregnancy develops in different species depends in part at least upon the readiness with which the stroma of the host responds with the production of a decidua favorable for the development of the embryo."

That the corpus luteum is not the sole source, or even the most important source, of the internal secretion of the ovary is sufficiently evident from the fact that during the period of life of sexual immaturity in which the internal secretion is performing its most important function of body formation, the corpus luteum is wanting. It is necessary, therefore, to seek in some place in the ovary other than the corpus luteum for the primary source of the internal secretion.

There are found in the ovary certain connective-tissue cellular elements, termed "interstitial cells," corresponding morphologically to the cells of Leydig, which are generally believed to constitute the source of the internal secretion in the testicle. These interstitial cells of the ovary occur in different form in different species of mammals. They correspond in histologic structure to the corpus luteum cells, being large and polyhedral in form, with granular protoplasm in which fat-like granules are embedded. The nucleus is relatively small, usually acentric, and is poor in chromatin. The cells have, like lutein cells, a yellow tint, and in this way resemble the interstitial cells of the testicle of many species. Just as in lutein cells and in the cells of Leydig, mitotic figures are not seen (Tandler and Gross).

The existence of the interstitial cells has long been recognized, having first been discovered by Pflüger in 1863, who demonstrated them in the ovaries of cats and dogs. Successive investigators found the cells in numerous species and finally in apes and in human beings. It was found that they occur with great inconstancy, in some species appearing in separate gland-like masses, in others as scattered cells. They also exhibit marked variations in the same species. Thus, in the embryo of the horse the interstitial cells are strongly developed, while toward the period of birth they become gradually less well defined (Born). In some species they increase at the time of sexual maturity and then diminish with age. In other animals they are most prominent during the spring of the year or during the season of rut. In still others they are affected by environmental changes, such as long-continued isolation. More recent investigation has shown that the interstitial cells become more highly developed after roentgenization of the ovaries, while in the male the homologous cells of Leydig undergo a like development as a result of vasectomy. These observations have paved the way for valuable experiments which have added much to our knowledge of the nature and morphology of the interstitial cells.

Equally interesting have been the speculations regarding the origin of these cells. Schroen in 1863 regarded them as fragments of disintegrating corpora lutea. His and Waldeyer considered them wandering cells. Tourneaux recognized the homology between them and the cells of Leydig, and ascribed

their origin to the pre-existing connective tissue, a theory which we shall see harmonizes with views of the present time. Schulin described them as epithelial structures; Harz, as offshoots of the glomeruli of the kidney; Chiarugi saw in them rests of the Wolffian body.

Limon was the first to recognize their origin from the lutein cells of the theca interna of the atretic follicles. Limon's views have been adopted by the best investigators, and it is now generally accepted that *the interstitial cells of the ovary either are identical with the lutein cells of the atretic follicles or at least are derived from them* (Tandler and Gross). The inconstancy of the appearance of the interstitial cells is explained by the fact that in some species or under certain conditions during the process of follicle atresia the theca lutein cells become "disaggregated," that is to say, separated from the surrounding envelope of the follicle (theca externa) and deposited in gland-like masses, or scattered indiscriminately through the ovarian stroma. Thus, in the rabbit, disaggregation takes place and the theca lutein cells are found in gland-like masses to which the term "interstitial gland" has been given.[1] In the human ovary, on the other hand, disaggregation takes place only rarely, and the theca lutein cells remain confined by the external envelope of the follicle. Hence an interstitial gland is not seen in the human ovary. It is quite conceivable that the function of the interstitial cells as producers of an internal secretion might be performed equally well whether limited by a theca externa or scattered in the stroma.

If we accept the theory of the identity of the interstitial cells and the follicle lutein cells, we must conclude that the production of the interstitial cells is, in reality, a function of follicle atresia.

If, now, it can be shown by animal experimentation and otherwise that the interstitial cells are producers of an internal secretion, then we must conclude that follicle atresia is not a pathologic but a physiologic process, the object of which is the elaboration of an internal secretion.

The detailed proof of the internal secretory power of the interstitial cells cannot be included in the scope of this section. We can only allude to the influence of the ovary on the growth of the individual before puberty as shown by early castration; to the experiments with roentgenization, showing the influence of the interstitial cells on secondary sexual characteristics; to the homology of the interstitial cells and the cells of Leydig, and to the effects of ovarian transplantation and ovarian therapy, in which the influence of the corpus luteum is excluded.

Thus we have sufficiently convincing evidence that the internal secretion of

[1] The interstitial gland is most pronounced in rodents, insectivora, chiroptera, and animals of prey. It is most apparent in early youth. With the appearance of the first corpus luteum the interstitial gland decreases, so that there seems to be a certain reciprocity between the corpus luteum and interstitial gland, which, as stated above, is derived from the theca interna cells of the atretic follicle. Good development of the interstitial gland in these animals is apparently associated with good fertility.

In animals that bear many young at the same time the interstitial gland is found highly organized at the age of sexual maturity, whereas in animals, like man, monkeys, and the hoofed animals, the gland is found poorly developed. In the latter case the gland is rudimentary at its best, and disappears completely after the appearance of the first corpus luteum (Aschner).

the ovary is manufactured both by the corpus luteum and by the atretic follicles. It is now necessary to point out the relationship between these two mechanisms from a physiologic standpoint. The exact nature of the lutein cells of the corpus luteum has been a matter of much discussion. Some have regarded them as epithelial in origin, others as derivatives of connective tissue. According to Pfannenstiel, the lutein cells are partly epithelial and partly connective tissue in structure. By this theory the innermost layers of cells toward the center of the corpus luteum represent a luteal reaction of the granulosa cells which develop from the original epithelial lining of the Graafian follicle; while the outer or theca layers represent a like reaction of proliferating cells springing from the connective-tissue envelope, or theca interna. These last named elements of the corpus luteum were termed by Pfannenstiel "theca lutein" cells. They correspond in the matured corpus luteum to the lutein, or interstitial cells of the atretic follicle.

The function of the theca lutein cells is probably twofold. The presence of fat in the protoplasm and the rich network of blood-vessels with which they are invested early suggested that they supply nutritive material for the development of the egg. The theory that they elaborate an internal secretion is of comparatively recent date. To them was first ascribed hypothetically a specific influence on the sexual impulse and the development of the secondary sexual characters, the latter theory being now well established by experimental proof.

Between the corpus luteum and the interstitial gland (*i. e.*, disaggregated interstitial cells in gland-like mass) an interesting reciprocal relationship has been pointed out by Bouin and Ancel, who have divided animals into two groups according to their methods of ovulation. To the first group belong those species in which ovulation occurs only after coitus, as in the rabbit, guinea-pig, mouse, and cat. Representatives of the first group exhibit a periodic corpus luteum and a corpus luteum of pregnancy, but not a well-defined interstitial gland; while those of the second group have a corpus luteum of pregnancy, but in place of a periodic corpus luteum an interstitial gland (Tandler and Gross).

It has been objected that the interstitial cells, being of connective-tissue origin, are not of the true endosecretory type, which is usually epithelial in character. This objection is met by the fact that certain other connective-tissue elements are known to possess endosecretory power, notably the suprarenal cortex and the cells of Leydig. It has been demonstrated that the endosecretory elements exhibit characteristic staining properties, and among these elements has been included a list of cells of connective-tissue origin, such as the cells of the serosa, the stellate cells of the liver, the reticulum of the blood and lymph apparatus, and the bone-marrow (Goldmann).

Another point of interest is the manner of growth of the interstitial cells. It is quite evident that they develop from the pre-existing connective-tissue cells of the ovarian stroma, which at a given moment "become activated" and take on the morphologic character and functional properties of interstitial cells (Tandler and Gross). It is conceivable, therefore, that the undifferentiated

stroma cells of the ovary have endosecretory powers which may be of value in the manufacture of ovarian extracts for therapeutic purposes.

An important phase in the study of the ovarian internal secretion is the question of the selective action of certain of the secretory elements. This part of the subject is at present very much in the dark. Fraenkel's assertion that the corpus luteum regulates the nidation and early growth of the egg is by no means universally accepted. The early theory that the corpus luteum presides over menstruation is no longer tenable, some even holding that menstruation is determined by the elimination of the corpus luteum. Loëb's view that the corpus luteum inhibits ovulation and that it is responsible for the growth of the maternal placenta is well established. Quite definite is the evidence that the interstitial gland presides over the development of the secondary sex development, experiments having shown that the sex characters remain if the purely generative portions of the ovaries are excluded by the Roentgen ray, whereas these characters undergo wide variation after early castration (Tandler and Gross). There is much to show, on the other hand, that the action of the ovarian secretion is neither direct nor selective, but that it exerts only a balancing influence on other correlated and more powerful glands, the activity of which the ovarian secretion discharges or suppresses, as the case may be.

Clinical manifestations of disturbances of the glands of internal secretion are caused either by deficient activity (hypofunction) or by an abnormal increase of activity (hyperfunction) of the glandular secreting substance. Under hypofunction must be considered not only the effects of diminished secretory power, but also the results of complete destruction or extirpation of the organ. In studying the effects of the removal or destruction of a given ductless gland one must take into account not only the influence of the loss of its specific secretion on the organism, but also the changes wrought in the other members of the group, the balance of whose function has thus been disturbed.

**Hypofunction of the Ovary.**—*Castration Before Maturity.*—We have seen that early castration prevents normal development of the genital system. It also produces changes in some of the other ductless glands, the most notable being that of the hypophysis, in which there takes place an increase in the size of the anterior lobe.

It is generally though not universally conceded that this hypertrophy of the hypophysis is the cause of the skeletal deviations and accumulation of fat that characterize the individual of the eunuchoid type.

Nearly all generalizations on this subject have been from observations of castrated males. In human beings information on this subject is gained chiefly from a study of the eunuchs of the Turkish harems and from a religious sect in Russia called the Skopts. It may be said that the body length of individuals who have been castrated early in general exceeds that of the non-castrated, an observation which is familiar in animals also, as in the case of oxen, geldings, and capons. Tandler and Gross and others ascribe this fact to a delayed ossifica-

tion of the epiphyseal joints, which produces not only an increase in growth, but a deviation from the normal body proportions. The result is that the individual produced by early castration is not, in general, of the infantile type, but, on the contrary, far removed from it. While we find in children a relatively long trunk and short extremities, and a proportionately large skull, with small face, we find in the castrated a marked increase in the length of the extremities and a skull relatively small in comparison with the face. These gross physical changes are constantly observed both in man and in animals, and it is not surprising, therefore, to find that there also usually exists an enlargement of the sella turcica due to hypertrophy of the hypophysis. It is, therefore, seen that the genital glands may bear an antagonistic relationship to the hypophysis, and that the early removal of the inhibitory influence of the testis or ovary, allows for an overdevelopment of the hypophysis with corresponding skeletal changes (Novak).

Another characteristic of the eunuch possibly referable to the increase of the hypophysis is the accumulation of adipose tissue which is usually though not always present. The muscles become permeated with fat. The distribution of fat over the body corresponds to that of the condition of dystrophia adiposo-genitalis, *i. e.*, in the hypogastric region, on the mons veneris, on the nates, hips and thighs, and on the mammary glands. There is also a characteristic deposit on the upper eyelids which may cause them to hang down like bags. There is a deficiency in the growth of hair.

The distribution of fat, especially over the hips and nates of the male castrate, produces a suggestively feminine appearance, which taken together with the absence of hair and the persistence of a high-pitched voice has led to the general belief that castration imparts to the individual characteristics of the opposite sex. This is emphatically not the case. The deposition of fat and the meager growth of hair are purely the result of internal secretory reaction. The high-pitched voice is not caused by a larynx of female type. The organ resembles rather that of a child, in that there is no prominentia laryngea and ossification has not taken place. "For this reason the voice retains its childish character and in no way resembles a woman's voice; it is a childish soprano which late in life undergoes the changes in timbre and tone characteristic of mutation" (Biedl). Apart from the high voice, deficient hair, and the general deposition of fat the eunuch does not approach the feminine type. The character of men castrated early in life has been variously estimated. They are said, in general, to be deficient in the courage, passions, and aspirations of normal men, but there is no diminution in intellectual capabilities. Some eunuchs have attained high positions. Temperamentally the castrated man is quiet and phlegmatic, a characteristic that could hardly be generally ascribed to woman.

It is important to emphasize the fact that early castration does not transform the individual into the heterosexual type, for it has a twofold significance. Not only does it have an important bearing on the subject of sex determination (*q. v.*), but it contradicts certain popular conceptions as to the after-results of late castration—a matter of considerable moment to the gynecologist.

Information regarding the results of castration before puberty in women is exceedingly meager. From the few observations made in the human race and from animal experimentation it may be assumed that early castration in women is followed by lack of development of secondary sexual characters including the breasts, and that the skeletal changes resemble those of the male castrate.

*Castration After Maturity.*—Whereas the effects of castration before puberty have been studied chiefly in men, the opportunity for observing the results of late castration is best afforded in women, in whom the operation for removal of the internal genital organs is frequently required.

From a physiologico-chemical standpoint the influence of castration after maturity has been extensively studied, but at the present time no very important results have been gained. Schickele has observed an increase in the arterial tension at the natural menopause and regards the effect as due to the loss of the depressor influence of the ovarian secretion. His observations have not been confirmed.

Variations in sugar assimilation, coagulation time of the blood, blood-picture, chemical composition of the blood, reaction to drugs, etc., have been described, but cannot be detailed here, as in our present state of knowledge they are of minor importance to the practical gynecologist. It is probable that many of these changes are the result of disturbing the balance of the other ductless glands, and that the abnormalities are produced by the internal secretion of organs whose influence on the general metabolism is more powerful than that of the ovary.

From clinical observations it may be said that late castration in women has comparatively little effect and that it does not entail the profound mental and physical change in the organism of the individual that was formerly supposed. Concerning this subject much will be said throughout this work (see especially section on Neurology). One of the popular misconceptions regarding the results of oöphorectomy is that certain features of the male type may be acquired, such as a deepening of the voice, increase of facial hair, coarsening of the skin, and a general assumption of the masculine character. Such ideas have doubtless been derived by reasoning from a reverse analogy to eunuchs. It has been pointed out above that even after castration before maturity there is not the slightest evidence of a transformation to the type of the opposite sex. This is seen not only in human beings, but in animals, and it may be definitely stated that after early castration the males of no species become feminine in type, nor do the females become masculine. If this fact is true after early castration it must certainly hold good after late castration when the organism has been permanently established both constitutionally and by habit.

Another exaggerated idea regarding late castration relates to the accumulation of fat. There is no doubt that there exists a certain relationship between adiposity and genital deficiency. This is seen in the results of early castration and in certain internal glandular diseases which are attended with lack of development or atrophy of the reproductive organs. In some instances where

functional amenorrhea appears in a previously normal woman there ensues an abnormal accumulation of fat, though in these cases there is usually a pluriglandular involvement. A noticeably large percentage of sterile women are fat. Much is said of the increase of fat in women who have reached the menopause, but this statement has undoubtedly been much exaggerated. Women who are destined to become fat usually begin to increase in weight long before the menopause, and often reach their maximum before menstruation ceases. Often the increase after the menopause is only apparent, for at that time the external tissues lose their firm contour and the fat settles into irregular and baggy folds, giving the impression of increase in size, though there may be no increase in weight.

In like manner the increase of fat after removal of the ovaries in adult women has been very greatly overstated, as any experienced gynecologic surgeon will testify. As a result of our personal experience we are able confidently to assert that castration of matured women is not ordinarily followed by a greater tendency to adiposity than is any other operation, though it may happen in rare cases.

The abnormal accumulation of fat that follows early castration is undoubtedly due to resultant changes in some other part of the internal glandular system, probably in the hypophysis. When castration takes place during full maturity the other glands of internal secretion are little affected, so that symptoms of disturbance are usually slight and transitory and often do not occur at all.

A similar difference between early and late castration is seen in the matter of the sexual impulse. In males who have been castrated before puberty sexual instinct is absent. When castration is performed after maturity libido is retained for a long time and copulation is possible, with ejaculation of the prostatic fluid.

In females early removal of the ovaries would undoubtedly be followed by complete absence of the sexual instinct. After oöphorectomy in matured women who have experienced intercourse and in whom the libido has been normally awakened the sexual impulse in the majorty of cases is retained for a number of years, though its duration is probably not as long as in normal women. It is not infrequently noted that late castration may produce for a time at least an actual increase of the libido. In our own record of cases a number of women have reported that the sexual impulse became somewhat less constant, but, on the other hand, more spasmodic and intense.

In the section on the relation of gynecology to sex it will be seen that in many normal women the libido is not awakened before sexual experience occurs, and then only gradually. It would be interesting and in many instances important to know if after the castration of a matured woman this awakening of the sexual impulse would take place as under normal conditions. So far as we can discover no observations on this point have been recorded.

From the foregoing the conclusion must be drawn that the sexual impulse after maturity is by no means exclusively dependent on the presence of the genital

glands. This dependence must be sought undoubtedly in the influence of other glands of internal secretion, a subject of the deepest significance which has not yet been elaborated. It has already been suggested (Cushing, Falta, and others) that the Freudian theory, which postulates an enormous influence of the libido in subconscious human motivation, may be explained on the basis of the internal secretions. It is entirely probable that many if not all the endocrine glands, in addition to their other physiologic properties, possess directly or indirectly sex-impelling attributes.

The most definite results of late castration in women are manifested by atrophy of the genital system and by certain temporary vasomotor disturbances. The subject of postoperative atrophy is mentioned below, and is again fully discussed in the special section on Genital Atrophy (*q. v.*). The subject of the vasomotor symptoms following oöphorectomy is elaborated in the section on the Relationship of Gynecology to Neurology.

*Infantilism.*—The relationship between early hypofunction of the ovaries and hypoplasia or infantilism is a subject about which there is much doubt. It is probable that most cases of infantilism are the result of some other cause than primary ovarian deficiency. (See also section on Infantilism and Sterility.)

Infantilism relates to arrested development of various parts of the body, and may manifest itself universally in all parts of the body (infantilismus universalis) or it may appear only locally (infantilismus partialis). The manifestations of the condition in which we are particularly interested are those that are seen in connection with the abdominal and pelvic organs and with the external female genitals, for some of them are of great clinical importance to the surgeon. Some of the familiar stigmata of the infantile or hypoplastic condition in the abdomen are enteroptosis, abnormal mobility of cecum and sigmoid, prolapse of the kidney, pelvic kidney, short appendiculo-ovarian ligament, funnel-shaped appendix, etc. In the pelvis there are the congenital or developmental uterine malpositions of retroflexion, acute anteflexion, anteflexion with retrocession, and procidentia, all of which may cause clinical symptoms. In addition to this are the anomalies due to the failure of complete union of the Müllerian ducts, causing the various forms of uterus didelphys and atresia, some of which may result in serious surgical complications. It was formerly supposed that these manifestations of infantilism were due to a deficient development of the ovary from the fact that the ovary is sometimes found hypoplastic. The present theory is that the local stigmata of infantilism, such as are seen in the genitalia, are merely manifestations of a general "hypoplastic constitution," and that hypoplasia of the ovary, when it occurs, is only an incident and not a cause of the general condition. In the great majority of these cases the uterus is distinctly infantile, but the ovaries are either normal or actually larger than normal (excluding the occurrence of cystic degeneration or thickened albuginea).

It is sufficiently evident, therefore, that infantilism is not necessarily due to ovarian deficiency. On the other hand, full development of the secondary characters may occur even in the complete absence of the ovaries. This is most commonly observed in cases of deficient union of the Müllerian ducts in which, according to Burrage, the ovaries are completely absent in 18 per cent.

In cases of absence of the vagina the ovaries are sometimes either absent or only rudimentary. Many of these women are in every other way fully developed sexually and are sought in marriage; hence, the not infrequent necessity of the operation for making an artificial vagina.

*Atrophy.*—Although up to the time of puberty the ovaries seem to have but moderate local or constitutional effect, we find definite evidence to show

that during the child-bearing and menstrual period of life the ovaries not only exercise a distinct trophic influence over the uterus and external genitals, but they seem to play a certain more or less important part in the general chemistry of the organism. This is best seen in the atrophy of the uterus and external genitals, which takes place when the ovaries become atrophied or are removed after attaining the period of full maturity. When atrophy of the ovary takes place the organ becomes shrunken in size, the follicles cease to ripen, and degenerative changes appear in the follicle apparatus. The condition when complete is manifested by amenorrhea. The uterus becomes small and flaccid, the cervix is shrunken and flattened. The labia become less full and rounded, the minora are slender and less prominent, and, finally, disappear entirely. The vaginal and vulvar mucous membrane is pale, inelastic, and contracted, and may give rise to most distressing symptoms. Physiologically, ovarian deficiency appears at the menopause and during lactation.

According to Thorn, lactation-atrophy of the ovaries with secondary atrophy of the uterus is a constant phenomenon in nursing women. Fränkel describes it as appearing during the third month after childbirth, and as disappearing in the seventh month even if the mother continues to nurse. Foges has shown that this atrophy is due to a cessation of the function of the ovaries and not to the nursing of the mother.

Pathologic ovarian deficiency, as indicated by secondary atrophy of the other genitals, is said to follow local pelvic conditions of inflammation and tumor formation, but this is rare, for in most cases the ovarian tissue continues to functionate even though only a very small portion is left by the disease. Ovarian atrophy sometimes follows infectious and constitutional diseases, such as scarlet fever, articular rheumatism, diseases of the thyroid, anemias, paralyses, etc. (See section on Genital Atrophy.)

*Functional Amenorrhea.*—The amenorrhea, or oligomenorrhea, that is seen in fully developed women, who have previously menstruated normally, is accounted for as a result of functional ovarian deficiency, a theory that finds strong confirmation in the almost immediate beneficial effect which ovarian extract usually has on these cases.

Burnam describes an ovarian deficiency which manifests itself in women of the fourth decade of life by lassitude, depression, and general ineffectiveness, a condition which he has been able greatly to benefit by the administration of large doses of corpus luteum extract.

How far sterility and dysmenorrhea are caused by hypofunction of the ovaries has not been determined. Ovarian extract occasionally influences these conditions, as shown by the most recent observations of the author.

**Hyperfunction of the Ovary.**—Our present knowledge of the influence of hypersecretion of the ovary is very theoretic and not sufficiently well founded on scientific facts. Abnormal activity of the gland is supposed to be manifested by menorrhagias and possibly by premature sexual development and

overfertility. From a clinical standpoint, the most important phase of the question is that which applies to those cases of uterine bleeding which cannot be satisfactorily explained on an anatomic basis. This includes cases even when certain demonstrable anatomic changes are associated with the bleeding, such as myomata, chronic endometritis, glandular hypertrophy, chronic metritis (increase of connective tissue), chronic oöphoritis, small cystic degeneration of the ovaries, etc.[1]

It also includes those baffling cases of so-called uterine insufficiency in which there is severe menorrhagia without macroscopic or microscopic change in the tissues of uterus or adnexa.

[1] Schickele and Keller, in an article (Arch. f. Gyn., 1912, Bd. 95, Heft 3) entitled "On So-called Chronic Metritis and Small Cystic Degeneration of the Ovaries; Their Relation to Uterine Bleeding," have supplemented their work on the relationship of the glandular changes of the endometrium to uterine bleeding. These investigators undertook to verify the theory of Theilhaber that the bleeding from cases of uterine insufficiency is due to an abnormal disproportion between the connective tissue and muscle-fibers of the uterine wall. In a very laborious piece of work they took sections from the myometrium of a considerable number of extirpated uteri. The sections were stained by the Van Gieson method and projected on millimeter paper, on which drawings were made of the connective tissue. In this way a fairly accurate calculation was made of the amount of connective tissue relative to the muscular fibers. Their calculations led them to conclude that uterine hemorrhages had nothing to do with the amount of connective tissue in the myometrium. Hemorrhages may occur with an associated hypertrophy of the connective tissue, or they may occur with a perfectly normal amount of connective tissue. On the other hand, abnormal bleeding may be entirely absent in association with great overgrowth of the connective tissue.

The same two investigators studied the ovaries of 7 cases of uterine insufficiency in which the uterus and adnexa had been extirpated, and found no characteristic anatomic changes in the follicles, connective tissue, blood-vessels, or albuginea, to which abnormal uterine bleeding could be assigned as a cause.

The careful studies of Schickele and Keller of the relationship between endometrium, myometrium, and ovaries, with abnormal uterine bleeding, are worthy of especial attention. Their general conclusions may be summed up as follows:

The idea that bleeding and leukorrhea are cardinal symptoms of so-called endometritis (gland hypertrophy) must in the future be modified. It is well established that severe hemorrhages may take place both during and outside of menstruation without the slightest change in the endometrial glands; on the other hand, marked conditions of gland hyperplasia may exist without any abnormal bleeding. There can, therefore, be no essential connection between abnormal uterine bleeding and changes in the endometrial glands. Although uterine bleeding and gland hyperplasia may exist at the same time, there is no reason for declaring that the bleeding is caused by the glandular condition. There is no anatomic characteristic change in the mucous membrane, which, as such, calls forth hemorrhage or leukorrhea.

The same thing may be said with regard to so-called chronic metritis (increase of connective tissue). There is, as a matter of fact, a true metritis, which depends for its origin on bacterial infection, and which on healing develops certain anatomic changes, but we have no proof how often this form occurs, what its anatomic characteristics are, and whether there exists any connection between it and uterine bleeding. Hyperplasia of the connective tissue cannot be looked on as an expression of such a chronic metritis any more than can the dilatation of the blood-vessels, which is also present.

It is certain that a hyperplasia of the uterine connective tissue does not necessarily produce abnormal bleeding. If there were any such connection between the two, we should have abnormal bleeding with every case of connective-tissue hyperplasia, and the greater the hyperplasia, the more intense would be the bleeding. This is not the case. Those cases in which, in spite of a normal amount of connective tissue, and, therefore, well-developed musculature, intense hemorrhages occur, make it still clearer that the real etiologic factor is something different and more important.

Everything forces us to the conclusion that the causes of abnormal uterine bleeding must be sought elsewhere than in the anatomic changes of the uterus. We naturally turn next to the ovary as the organ which would be most likely to influence the uterus. In the ovary anatomic changes can be demonstrated which may occur simultaneously with atypic uterine bleeding. However, it is an established fact that these same atypic bleedings may take place without any demonstrable anatomic change in the ovaries. This fact leaves the significance of the above-mentioned changes of the ovaries in a very uncertain light. We do not even know whether the functional processes in the ovary express themselves in its anatomic structure; whether any anatomic changes of the ovaries signify the outer sign of functional disturbances. Under such conditions the reputed significance of chronic oöphoritis or of small cystic degeneration falls to the ground. We have at present no clue by which we can judge the function of the ovary by its anatomic appearance.

The belief that most uterine bleeding is the result of a hypersecretion of the ovary is based on the theory of interrelationship between ovarian secretion and menstruation, the course of reasoning being as follows:

The functions of the uterus are under the control of the ovaries, for without the ovaries there is no true menstruation. During menstruation the blood-vessels of the uterus, and especially of the endometrium, are always dilated and the normal menstrual blood is uncoagulable. It is supposed, therefore, that there is manufactured in the ovaries as an internal secretion a substance which passes over into the uterus in the blood, and which, when enough of it has accumulated, produces the phenomenon of menstruation by dilating the capillaries of the endometrium and reducing the coagulability of the blood.

The substance (probably by chemical influence) acts on the walls of the small blood-vessels of the endometrium, causing a hyaline change which makes them more permeable for the passage of the blood. The menstrual bleeding stops when the active substance which causes dilatation of the blood-vessels and non-coagulability of the blood is eliminated by the flow. The ovaries continue to manufacture the substance, which in turn continues to flow over into the uterus until enough is accumulated to produce again the menstrual discharge. By this theory, therefore, abnormal uterine bleeding is easily explained by the storage in the uterus of an excessive amount of ovarian secretion.

This theory is not without scientific substantiation. Of very great interest are the experiments of Schickele on the influence of uterine and ovarian extracts on the time coagulability of the blood. He made extracts of the uterus, endometrium, and ovaries that had been removed for various causes at surgical operations, and, adding them to combinations of animal blood-serum and plasma, observed the changes in the time of coagulation as compared with normal controls. From these investigations he proved that extracts of the uterus and ovaries delay the coagulation. In those cases where the extracts were made from organs in which abnormal bleeding had not existed he found that the ovarian extract caused a greater delay than did that from the uterus. In those cases where there had been severe menorrhagia or other hemorrhages, the effect of the uterine extract was more powerful than that of the ovaries. Moreover, he showed in these cases that the extract from the endometrium was more powerful than that from the myometrium.

The general conclusion was that extracts from organs in which the menstruation had been unduly prolonged caused a greater delay in blood coagulation than did the extracts from organs where menstruation had been normal.

The conclusion from the foregoing is that in the ovaries is produced a substance that is passed over to and stored in the uterus and endometrium, which has the power of local dilatation of the blood-vessels and of delaying or preventing the coagulation of the blood. Hyperfunction of the ovary causes an oversupply of secretion, and thus brings about increased or prolonged menstrual flow.

**Ovulation and Menstruation.**—It has long been a mooted question as to whether a definite relationship exists between the time of ovulation and menstruation. Observations on this point vary considerably in the study of the human ovary chiefly on account of the difficulty in determining the exact age of the corpus luteum.

In order to facilitate the accumulation of evidence on this subject Frank has epitomized his own work and that of others in an excellent description of the macroscopic and microscopic appearance of the corpus luteum in its various stages. The reader is referred to this article for the microscopic details (Surgery, Gynecology, and Obstetrics, Nov., 1914). In this

review the life of the corpus luteum is divided into four stages, the macroscopic appearances of which are herewith given verbatim in order to aid the operator who wishes to make a series of observations of his own:

(*a*) *Proliferative Period.—Macroscopically,* immediately after ovulation the ruptured follicle appears as a small, flaccid, collapsed vesicle. This lack of prominence accounts for the fact that numerous investigators have overlooked the earliest stage. Confusion has also arisen from the gross and also microscopic resemblance of the atretic follicles to early corpora lutea.

(*b*) *Vascularization.—Macroscopically,* the corpus luteum appears as a typical bluish-red prominence on the surface of the ovary. It is indistinguishable from the later stages. On cross-section more often than at a later period the central coagulum is fluid or jelly-like in consistence and its center may be freed from blood, but no absolute diagnostic value can be accorded to these differences.

(*c*) *Period of Ripeness.—Macroscopically,* the external appearance does not differ from that of the just vascularized corpus luteum. On cross-section, especially toward the end of this stage, the central coagulum may be firmer, and a well-defined yellowish-brown crenated margin (the lutein edge) may surround the clot. Not infrequently the center of the corpus luteum is cystic.

(*d*) *Period of Regression.—Macroscopically,* the corpus luteum looks paler. On cross-section the centrum is more solid and colorless; instead of this, the center may remain cystic. The crenated margin is of brighter yellow color, broad, and well defined.

(*e*) *Corpus Luteum of Pregnancy.—Macroscopically,* it is often larger than the corpus luteum of menstruation; but it cannot be differentiated from it with any degree of certainty.

Though a definite time relation between ovulation and menstruation is no longer disputed, the exact period of the relationship has not yet been determined. Various estimates have been made, but, according to Frank, we are justified in the present state of our knowledge in "concluding merely that ovulation follows menstruation and that the fertilized ovum (impregnation) dates from before the missed period."

There is evidence to show that impregnation usually dates from within the first week following menstruation, and that the optimum time for fertilization is immediately after the menstrual period.

Meyer and Ruge have described the relationship between ovulation and menstruation as follows:

"In the 28-day cycle of menstruation the ripening of the follicle probably comes after menstruation on about the eighth day from its beginning, if not during the time of menstruation itself. The beginning of lutein formation is the second week; then the hemorrhage follows in the second half of the third and in the fourth week. The height of the hemorrhage follows in the second half of the third and in the fourth week. The height of the hemorrhage is immediately preceding menstruation. During the latter regression begins and lasts about fourteen days. The normal sequence is then as follows: first, the hyperemic stage of the corpus luteum during the interval; the stage of vascularization of the corpus luteum at the beginning of the premenstrual phase; hemorrhage of the corpus luteum in the advanced premenstrual phase; the high point of hemorrhage of the mucosa and of the corpus luteum shortly before menstruation; and the regression during and after the same. During pregnancy the corpus luteum remains at the high point of its hemorrhagic state."

The prevailing theory that there exists a definite time relationship between ovulation and menstruation has been upset somewhat by the investigations of Leopold and Ravano. Their conclusions may best be presented in the following quotation from Biedl:

"Menstruation, that is, the periodic emission of blood by the uterine mucous membranes, depends upon the presence of the ovaries and the development of the uterine mucosa, and not solely upon the bursting of a Graafian vesicle. In the greater number of instances there is, both before and during the bursting of the vesicle, a determination of blood to the ovary. This is, in all probability, the reason why ovulation and menstruation are frequently coincident. Ovulation may take place in accordance with a specific periodic cyclic process, or its occurrence may be irregular; as a general rule, however, its periodicity coincides with that of menstruation.

"In more than a third of instances ovulation and menstruation are not simultaneous. Ovulation may take place at any time, and is not necessarily accompanied by uterine bleeding. *This fact makes it appear extremely probable that conception also can occur at any time.*

"Menstruation may take place without ovulation. At the period when the ovaries undergo senile involution they sometimes contain normal Graafian follicles and corpora lutea, which seems to show that the process of ovulation may outlast that of menstruation.

"It is evident from the above statements that Fränkel's theory of the dependence of menstruation upon ovulation and upon the internal secretory function of the corpus luteum is untenable."

J. R. Goodall (McGill University), whose work on the physiology of the pelvic organs entitles his opinions to the highest regard, writes as follows:

"We feel that the relation between ovulation and menstruation is a very loose one. Let us inquire into the relationship more closely. What is it that causes the periodic congestion? To this a positive answer can be given. It is ovarian function. And to be more definite, it is the development of a Graafian follicle. It is the monthly discharge of ovarian function, which is ovulation. Now menstruation is related to ovulation only in this, that the healthy developed uterus at that time will develop a pseudodecidua preparatory to receiving the fecundated ovum, and if impregnation does not take place, the uterine mucosa, under the influence of the pelvic congestion, will bleed by a process of diapedesis or rhexis. If impregnation takes place some time before pelvic congestion has reached its height menstruation will not occur. But if impregnation takes place immediately before the height of pelvic congestion, menstruation will occur, though modified by the time which has elapsed between the fecundation and the menstruation which should not have occurred.

"By this we wish to prove that uterine hemorrhage is but a factor in the reproductive cycle, but it is a factor of a more or less passive nature, and we would go still further and state that uterine hemorrhage is but an index of retrogressive changes in a special decidual tissue developed for a special cause. When the pregnant ovum does not become implanted upon the specially prepared bed retrogressive changes ensue and the decidual tissue and hypertrophied mucosa must return to the quiescent intermenstrual state. This retrogressive change is first evidenced by a soddening of the tissues with lymph, weakening of the arterial walls by edema, and finally the vessel walls rupture under the pressure of the blood-stream and uterine hemorrhage ensues.

"It will be seen then that the uterus is more or less passive. The active agent is the ovary, with its function of ovulation. This function brings about pelvic congestion, and the uterus takes part in the menstrual congestion. Therefore lack of ovulation will mean lack of menstruation because lack of ovulation implies lack of pelvic congestion. But the converse is not necessarily true, that lack of menstruation means lack of pelvic congestion and lack of ovulation. For example, it has been the experience of every general practitioner to have had cases where impregnation took place during the amenorrhea of lactation. Many cases are also on record of pregnancy before puberty and of pregnancy after menopause. It is a well-known fact that ovulation goes on regularly in children long before puberty. Our sections show that ovulation goes on regularly in infants, yet they do not menstruate. We stated above that normal menstruation is but the index of the influence of pelvic congestion, *i. e.*, ovulation upon a healthy, developed uterus, in a healthy individual. If the uterus is infantile or undersized it will not menstruate, or will menstruate irregularly and scantily, and this irregularity is due not to changes in the uterus, which allow it to menstruate some

months and not at others, but the irregularity is due to fluctuations in the degree of pelvic congestion. The absence of menstruation under such circumstances does not mean the absence of the chain of uterine changes which are coincident with pelvic congestion. It means the presence of all these, but in a minor degree that does not permit of rupture of the blood-vessels and hemorrhage, and necessarily the quantity will be small. On the other hand, where the uterus or its mucosa is diseased, where the mucosa is thickened and hypertrophic, the degree of change at the menstrual epoch will be greater, the mucosa will be thicker, and the vessels will be more numerous and the quantity of blood lost will be greater.

"Hence, normal uterine hemorrhage is the index of a normally developed, normally functioning, healthy uterus and uterine mucosa. We are convinced that ovulation and pelvic congestion go on regularly every month from infancy to menopause—and frequently beyond—without interruption, and that uterine hemorrhage is but a sequence, but not a necessary sequence, and will depend for its absence or for its presence, for its regularity and for its irregularity, for its scantiness and for its excess, upon conditions quite apart from ovulation. These determining conditions may be uterine or extra-uterine, and we need not stop to inquire into these. Our readers will note that we did not state that 'the characters of the menstrual flow will depend upon conditions quite apart from ovulation and pelvic congestion,' but we did state that the characters will depend upon conditions quite apart from ovulation. It will be readily seen that the character of the pelvic congestion will be quite independent of ovulation—the cause which provoked it. Many factors may enter to increase or decrease the determination of blood to the pelvis. But these are independent of ovulation, and may best be spoken of as complications. Such, for example, are pelvic inflammations, ectopic gestation, cardiac disease, and new growths.

"From the foregoing it will be seen what a very fluctuating sign menstruation really is; how it is acted upon by so many extrinsic causes, not only as to its periodic regularity but also as to its quality. Its vasomotor system seems to be less under the dominance of the higher nervous centers than is the vasomotor system of other organs. The vasomotor changes which find their expression in spells of fainting which follow upon great mental shocks find their analogue in the amenorrhea in great nervous shocks. Moreover, it has been the experience of every gynecologist and obstetrician to find the recurring pains of menstrual dysmenorrhea of young girls cease suddenly for a while when the physician enters, and the same expression of nervous influence is seen in the cessation of uterine labor-pains when the accoucheur arrives.

"From this it must follow that changes in menstruation as to regularity and quantity must be interpreted with the greatest care."

**Ovarian Transplantation.**—Perhaps the most striking evidence that the ovary is an organ of internal secretion is seen in the effects produced by implantation and transplantation of ovarian tissue. By these experiments the ovarian influence by direct nerve connection is excluded, and it is clearly established that the ovary secretes a substance that acts chemically on distant organs through the agency of the blood-stream.

Experimentation has shown that in young castrated animals the genitalia may be made to develop normally at the time of maturity if ovarian tissue is implanted under the skin. In female baboons, a species which exhibits a menstrual function similar to that of the human female, menstruation may be preserved after extirpation of the ovaries by transplanting the glands to various parts of the body. Experiments such as these are conclusive proof of the chemical influence of the ovarian secretion. Much work has been done in the transplanting of ovaries, and reports vary considerably as to the anatomic fate of the transplanted tissue. Conclusions from the reports of others and from our own

FIG. 23.—OVARIAN TRANSPLANT IN HORN OF UTERUS AFTER SIX YEARS.

1, New vessels that have formed between the uterine and ovarian tissues. 2, Junction of uterine and ovarian tissues. 3, Corpus albicans. 4, Atretic follicle.

Note that the surface of the ovarian graft did not become adherent to the surrounding tissues.

History of the case: Operation May 3, 1910. Double salpingectomy, with transplantation of ovarian tissue in each horn of the uterus. Both ovaries preserved. Four years later patient reported that she had a miscarriage at three months. Statement corroborated by attending physician, but no fetal tissue preserved for confirmation.

Operation June 6, 1916. Hystero-oöphorectomy for ovarian cyst and pelvic adhesions. Both operations performed by the author at the Free Hospital for Women, Brookline.

observations show that an ovarian graft, if it "takes" successfully, continues to live and functionate for a time and then gradually becomes converted into functionless fibrous tissue. The life of a graft depends on numerous factors. Autoplastic grafts that have been removed and reimplanted in the same individual take better and live longer than do homoplastic grafts in which the gland is transferred from one subject to another of the same species. This is due to the physiologic antagonism of blood and tissue that exists between different individuals. Homoplastic transplantation is more successful when there is a blood relationship between the two individuals than when they are entirely unrelated, for in the former case the physiologic antagonism is less intense. The success of an ovarian graft depends to a certain extent on the length of time between extirpation and transplantation. Thus, a graft that is made immediately is more favorable than one where the gland is preserved for a time in cold storage or where it has been treated with some chemical, such as iodin, or heated for the purpose of bacterial sterilization. The location of the graft is also important for the maintenance of the life and function of the gland, it being necessary that the tissue in which it is embedded should be sufficiently vascular to insure the establishment of a new blood-supply to the gland.

The life of an ovarian graft even when successfully planted is quite inconstant and varies from two or three months to a year. In some well authenticated cases it has extended to two or even three years.

The histologic changes that occur in a human ovarian graft may be seen by referring to the drawing (Fig. 23). In the case here depicted the ovarian tissue was removed six years after autotransplantation into the horn of the uterus. It will be seen that active follicular development has practically ceased. There are the remnants of an old corpus luteum and in one place can be seen a small atretic follicle. No primordial follicles are visible. This was evidently an unusually successful graft, as is demonstrated by the well-marked vascular connection established between the ovarian tissue and its new host. In this case, as always happens, there took place a considerable diminution in the bulk of the transplanted tissue. Enlargements frequently noted in grafted ovaries are from our personal observations due to cystic degeneration of the follicles, and not, as some claim, to a regeneration of the ovarian parenchyma.

To the gynecologist ovarian transplantation has been a subject of peculiar interest, in that it seemed to promise a solution of many difficult pelvic problems. Practical results have, however, up to the present time been disappointing, but it is quite possible that with improved technic and with a greater knowledge of the physiology of the ovarian functions some of the hopes for its usefulness may in time be realized.

In the treatment of sterility ovarian transplantation in the human female has been especially disappointing. A number of successful operations in animals of heteroplastic transplantation have been reported, as in the following experiment cited by Martin:

"W. E. Castle and John C. Phillips (70) reported in *Science*, 1909 that ovaries were removed from an albino guinea-pig about five months old, and in their stead were introduced the ovaries of a black guinea-pig about one month old. The albino upon which the operation had been performed was then placed with an albino male guinea-pig and six months later bore two black-pigmented young. In many hundreds of matings of albino guinea-pigs observed by the authors only albino young were produced; so there seems no room for doubt that in the case described the black-pigmented young derived their color from the black animal that furnished the ovaries."

A similar result in the human female was reported by Halliday-Crom in 1905, who claimed to have brought about pregnancy and a full term child by engrafting in the uterus of a castrated woman ovarian tissue from another woman. Morris reported a similar case in 1906. Numerous reports of pregnancy following autoplastic grafting of ovarian tissue in the uterine horns after complete bilateral salpingectomy have appeared in the journals. In most of these cases there has been a history of abortion. Most of them, like that of the author (page 61), lack irrefutable evidence. We have performed this operation many times without success as regards the maintaining of fertility.

Ovarian transplantation has been used in the treatment of women who have by surgical operation suffered the loss of their ovaries, but with the retention of the uterus. The operation of double oöphorectomy without removal of the uterus is to be deplored, in that it is usually followed by discomforting pelvic and vasomotor symptoms, often of extreme severity and long duration. Several such cases have been reported in which transplantation of ovarian tissue from another woman has been done followed by temporary reappearance of menstruation and remission of ablation symptoms. The results of such an operation are extremely inconstant, owing to the difficulty of successful grafting in homoplastic transplantation.

It was stated above that in unmatured animals normal development of the other genitalia follows castration if the ovarian tissue be transplanted in some part of the animal's body. In a similar manner, after castration of the adult human female, genital atrophy may, for a time at least, be prevented and the menses continued if ovarian tissue is reimplanted. Such a result ensues only if the uterus is left *in situ*. Menstruation in these cases is reestablished usually after three or four months following the operation. A like result may be obtained less constantly by transplantation of ovarian tissue from another woman. Here again the procedure of grafting has only a limited field of usefulness, for it does not ultimately do away with the disadvantages of removing both ovaries and leaving the uterus. It may be said also that ovaries that are so diseased as to require removal from the pelvis are not usually suitable for implantation in some other part of the body.

The most promising field for ovarian transplantation would seem to be in cases where hysterectomy with removal of non-diseased ovaries is required, in which it might be expected that the engrafted organ would supply an internal secretion sufficient to prevent ablation symptoms of hot flushes and other vasomotor disturbances. The operation has been performed many times by different

surgeons whose opinions as to its efficacy vary considerably. Some believe that ablation symptoms are definitely and faborably influenced by the transplanted ovary; others have found it of little benefit. We have carried out the procedure in many cases and have carefully followed up and tabulated the results. In our series of cases as compared with hysterectomy cases with total ablation of the ovaries we have found practically no difference in the incidence or intensity of the surgical menopause symptoms. It was our custom in the earlier operations to transplant ovarian tissue after hystero-oöphorectomy in the leaves of the broad ligament. In this situation the ovarian graft in several cases became cystic and painful, and in one instance apparently produced distressing molimina with vicarious epistaxis. In the later operations the graft was inserted in a pocket made between the abdominal rectus muscle and its aponeurosis. In a few instances the section of gland became more or less periodically enlarged and tender, due undoubtedly to cystic degeneration of the follicles. In one case the gland grew rapidly to nearly the size of a fist and then suddenly collapsed. Some recommend planting the ovary in the subcutaneous fat. In a case in which this method had been used and which later came under our observation the ovarian tissue became extensively cystic, spreading through the fat and requiring several operations for its complete removal.

From the foregoing experiences our conclusion has been that the operation of transplantation after hystero-oöphorectomy is of little or no practical value. When the graft has been made in some easily accessible place the operation cannot be followed by any serious harm, and in certain cases, chiefly for sentimental reasons, it may be advisable.

Our observations regarding the feasibility of ovarian transplantation after hysterectomy are substantiated by Tuffier, who remarks that "where the uterus is absent ovarian transplantation is of no value."

There is a possible field for ovarian transplantation in the treatment of the functional amenorrheas of young women. So far as we can discover there has been practically no work done along this line. The following experiment, performed by the author, is presented not as conclusive proof of the value of the procedure, but as an interesting suggestion that a remedy may be found for a difficult gynecologic problem:

Two amenorrheic women came to the hospital at the same time. One of them, twenty-six years of age, had menstruated only a few times in her life. She had been married five years, without children. She was perfectly developed both as to her primary and secondary sexual characters. The second was a young woman of twenty-one who had menstruated only two or three times in her life, the last time four months previous to her coming to the hospital. It happened that there was at the hospital at the same time a woman who had had menorrhagia and metrorrhagia for five years as a result of uterine insufficiency. Repeated curetings had been of no benefit. The uterus was anatomically normal. The Wassermann test was negative. Inasmuch as a hysterectomy seemed advisable, it was determined to graft ovarian tissue from the menorrheic woman into the two amenorrhoic patients. Accordingly, during the hysterectomy on the last named patient, sections were taken from the ovary in which there was no corpus luteum. These sections were immediately transplanted into the anterior cervical lip of the amenorrheic patients. The first patient a few days after the operation had a perfectly

normal menstruation for the first time in three years. The second patient menstruated normally in about twelve days and has menstruated regularly since for about five months.

In these two cases the action of the ovarian internal secretion was apparently exerted by a portion of ovarian tissue from which the influence of the corpus luteum was excluded.

**Organotherapy.**—The therapeutic value of extracts of ovarian substance has passed beyond the stage of theory and speculation and is now an established fact beyond all doubt. With regard to the nature of the active substance, the exact location in the ovary of its manufacture, and many other questions we are still considerably in the dark. The earlier reports of the use of ovarian extracts were, for the most part, discouraging, but in recent years better preparations, a more definite knowledge of the physiology of the ovary, and a more intelligent selection of cases for treatment have yielded results that are not only satisfactory, but often astonishing.

The value of ovarian therapy is seen in the treatment of patients who are suffering from functional deficiency or absence of the ovarian internal secretion. The most conspicuous examples of this are those who experience the vasomotor disturbances of the natural or artificial menopause, the symptoms of which consist chiefly of hot flushes, vertigo, etc. By the administration of a properly prepared extract these symptoms are, with some exceptions, greatly benefited or made to disappear entirely. The extract is, therefore, of the greatest help in the routine postoperative treatment of patients who have undergone hysterectomy, at least 80 per cent. of whom suffer from vasomotor changes.

Next to its importance in menopause cases is its value in treating young women with functional amenorrhea and oligomenorrhea. Its results with these patients are not as constant as in the first class of cases, but its use is here successful, either partially or completely, in the majority of instances.

A third type of cases in which ovarian therapy is surprisingly efficacious is represented by patients suffering from deficient circulation of the external genitalia. As is elsewhere stated (see page 47), animal experimentation has proved that the ovarian internal secretion has a specific hyperemic effect on the external genitalia. Substantiation of these experiments on animals is seen in the beneficial effect which ovarian extracts have on the conditions of pruritus, kraurosis, furunculosis, and other affections of the vulva in elderly women where the local disturbance of the parts is due to inadequate circulation.

Aschner has been able to produce hemorrhage and even hematometra in guinea-pigs by the injection of ovarian extract. He finds in animals thus treated that the ovaries contain an unusual number of ripening follicles, and ascribes to this phenomenon the hemorrhagic congestion of the uterine mucosa and the hyperemia of the external genitals. Aschner has also found that placental extracts work still more strongly than ovarian extract, and suggests that they be used in amenorrhea, sterility, and climacteric disturbances.

In the treatment of the foregoing classes of cases the evidence of the value of ovarian organotherapy is beyond dispute, and is entirely substantiated by a large experience in its use by the author.

In addition to these three types, various other gynecologic affections are

reported to be greatly benefited by ovarian extract. Burnam has had marked success in treating neurasthenic underpar women in the preclimacteric decade. Dannreuther reports success in bringing a patient to term after repeated abortions, and finds the treatment helpful in the hyperemesis of pregnancy.

A few cases have been reported of the cure of sterility, but its efficacy in this respect is extremely doubtful.

In conditions presumably due to hypersecretion of the ovaries and menorrhagia, as one would expect, organotherapy is of little assistance.

There is at present much discussion and experimentation in the matter of the form of the extract. On the almost universally accepted theory that internal secretion of the ovary is manufactured by the corpus luteum, most extracts nowadays are made from the yellow body of either pigs or cows. On the ground that the corpus luteum of pregnancy is more stable than that of ovulation, it is considered by some (Dannreuther) of the greatest importance that the preparation be made from pregnant animals. On the other hand, the author, whose results compare favorably with those of the most enthusiastic users of the corpus luteum, has employed an extract from the entire fresh ovary which he has found equal in effect to the lutein extracts.

The use of ovarian extracts is not dangerous, there being no toxic effects excepting a slight disturbance of the stomach. Dannreuther lays considerable stress on the depressing effect of continued doses on the blood-pressure. This is probably more noticeable in the case of corpus luteum extract than in that of the whole ovary.

The dosage is the same whether corpus luteum or ovarian extract is given, 5 gr. three or four times daily. In most of the preparations now used 1 gr. of the extract represents 6 or 7 gr. of the fresh ovarian substance.

It is of absolute importance that the preparation be fresh, the use of stale extracts probably accounting for many of the unsatisfactory results reported.

It is quite probable that with a better chemical knowledge of the ovarian substance, and with improved methods of preparing and administering the extracts, there will in time be a notable advance in the use of this already invaluable remedy. There is no doubt that in the change from the ovaries to the commercial extract important ingredients of the ovarian secretion are disturbed. That only a part of the full effect of the secretion is reproduced is shown by the fact that whereas ovarian therapy is eminently successful in treating disturbances of the menopause, it has no effect on stopping uterine atrophy. Moreover, it must be remembered that while in the body the ovarian secretion passes directly into the circulation, ovarian therapy requires that the substance pass through the digestive apparatus, so that a chemical disturbance in the secretion is more than probable (Bab).

It has been justly asserted that most of the work thus far done on ovarian organotherapy[1] has been unscientific in character, and that the clinical results from its use which have been reported are, therefore, in large part untrustworthy.

[1] The material of this section is for the most part taken from an article by the author entitled "Ovarian Organotherapy. A Preliminary Report," Jour. Amer. Med. Assoc., vol. lxix, No. 9.

The lack of greater progress in this important subject is due to certain impeding factors which serve as a serious handicap to proper scientific investigation. Foremost among these factors is the vagueness of our knowledge of the physiologic processes of the pelvic organs. We are secure in our belief that the ovary is an organ of internal secretion, but it has not yet been proved conclusively in what part of the organ the secretion is manufactured. Moreover, we are quite at a loss to know whether the secretion of the ovary acts directly on the organism or whether it serves only as a balance to the products of more powerful glands in other parts of the body. In addition to our ignorance of pelvic physiology we are greatly hindered in the study of ovarian extracts by the fact that it is impossible to make standard tests for most of the clinical reactions for which administration of the extract is chiefly indicated, animal experimentation being inadequate on account of the exclusively human character of the reactions. The admirable experiments of Frank and others, showing the effect of ovarian extracts on the uterine tissue of castrated animals, are valuable in proving the actual existance of an active internal secretion in the ovary, but they do not lead us to definite information as to the effect of the ovarian secretion on such complicated human phenomena as menstruation and the vasomotor symptoms of ablation.

A serious handicap in the study of ovarian therapy is the fact that the nature of the secretion is not yet known. On account of this doubt as to the nature of the potent substance there has been no effective standardization in preparing the various extracts used clinically and experimentally.

As a result of our deficient knowledge of the physiology of the pelvic organs and the consequent limitation to more scientific methods of research, most of our information bearing on the subject of ovarian organotherapy has been derived from observations made in a somewhat haphazard way in connection with the clinical administration of the numerous commercial preparations put on the market by various drug firms.

Thus it happens that there is a very wide divergence of opinion among clinicians in the matter of ovarian therapy. Many assert that the administration of ovarian substance is entirely valueless in any condition. Such testimony may, however, in the light of recent experience be disregarded. The chief controversy lies in the question as to which part of the ovary is most efficacious therapeutically, some advocating the corpus luteum alone, others the entire ovary, while, as will be seen, the author recommends the ovarian substance from which the corpus luteum has been excluded. Experience shows that all these three preparations have essentially similar physiologic effects when used in certain conditions, variations occurring only in the intensiveness of the results. It may be said that in all preparations the most striking results are obtained in the treatment of the vasomotor symptoms of the menopause. All of them will benefit a certain number of cases of amenorrhea and oligomenorrhea and of circulatory disturbances of the external genitals. It seems probable, therefore, that the active substance is the same, whether the extract be made from the corpus luteum or from the rest of the ovary. Therefore in selecting a part of the ovary for the extraction of the secretory substance, it is a matter of choosing that tissue which shall yield the substance in greatest abundance, and with the least toxic effect on the patient.

Present knowledge indicates that there exist both in the corpus luteum and in the atretic follicles cellular elements identical in their origin from a specific connective-tissue structure (the theca interna) and capable of producing an internal secretion which is important to the growth and normal functioning of the organism. If this is true, we have a basis on which to found a rationale for ovarian therapy.

If an internal secretion is manufactured from both the corpus luteum and the atretic follicles by cells of identical structure, extracts made from the corpus luteum alone lack that valuable part of the secretion which is derived from the atretic follicles. Moreover, it is impossible to tell by inspection whether a given corpus luteum is in the process of maturation or at the height of its development, or in a stage of involution and disintegration. It must happen that in the preparation of many corpora lutea for therapeutic purposes a varying number are included in which the essential cells are no longer active as organs of internal secretion, and are actually in a condition of dissolution. We should expect, therefore, that commercial preparations of corpus luteum would present a wide variation in their therapeutic effects, and, owing to their readiness to decompose, would have a special tendency to become toxic.

On the other hand, if the preparation be made from the whole ovary, including corpus

luteum, stroma, and follicles, the important follicular secretion is not lost. Preparations of this kind would be expected to be more stable in their composition and more constant in their effect than those of the corpus luteum alone. These conclusions have been amply borne out by our clinical experience.

Reports regarding the results of ovarian therapy are, for the most part, inadequate and contradictory. We shall, therefore, in discussing the subject confine ourselves to observations made from personal experience.

In estimating the comparative merits of preparations of the whole ovary and those of the corpus luteum alone, most of our observations have been made in treating the vasomotor symptoms following hysterectomy. In this type of case the corpus luteum showed a great variation in effectiveness, often being entirely valueless and occasionally producing digestive disturbances. On the other hand, the whole ovary, used in a large number of cases, showed great constancy in therapeutic effect, so that we have come to regard it as almost a specific in the treatment of ablation symptoms, both of the artificial and natural menopause. Striking results have also been obtained in the treatment of functional amenorrhea and in the circulatory disturbances of the external genitals, such as kraurosis and the discomforts of senile atrophy.

In order to test further the effect of luteal preparations compared with those of the whole ovary a series of clinical observations was undertaken with desiccated corpora lutea of pregnant animals. Numerous cases were treated, representing hot flushes from the menopause, oligomenorrhea, dysmenorrhea, and amenorrhea. In all but two of the cases toxic symptoms of a digestive nature were produced. Preparations from both the cow and the pig reacted in the same way. The symptoms were invariably those of nausea and vomiting following one or two doses. In one case the ingestion of one 5-grain capsule resulted in continuous nausea and occasional vomiting for a period of ten days. The result of these clinical experiments cannot easily be explained. It was at first thought that the effects might be due to decomposition of the extract, but fresh preparations produced the same symptoms. They could hardly be due to anaphylaxis on account of the high percentage of patients affected.

These observations suggest the possibility that the nausea and vomiting of pregnancy may be determined by the toxic effect of the internal secretion of the gestative corpus luteum.

In view of the favorable results obtained from the whole ovary compared with the corpus luteum alone, and of the positively bad results from the corpus luteum of pregnancy, we next determined to try the effect of the ovarian substance alone minus the corpus luteum.

In this experiment the ovaries of pregnant animals were chosen partly as a check to the experiment with the gestative corpus luteum and partly to test the therapeutic effect of the internal secretion of the atretic follicles. It was thought that pregnant ovaries would be particularly favorable for studying the follicle internal secretion, owing to the well-known fact that during pregnancy the process of follicle atresia is especially active.

The results with this substance were interesting. The toxic effect created by the corpus luteum of pregnant animals was entirely absent, thus showing that its poisonous reaction could not have been anaphylactic in character. The new substance produced results similar to those of the non-pregnant ovary, but, in general, more striking. This was especially true in the treatment of vasomotor symptoms following hysterectomy. The preparation proved generally successful in the treatment of hot flushes, and in some cases of amenorrhea, dysmenorrhea, intermenstrual pain, catamenial nausea, headache, and the genital discomforts of senile atrophy.

From observations made with this substance, incomplete as they are, we have at least suggestive evidence that an internal secretion is elaborated from the follicles which in therapeutic value is equal to and probably greater than that produced by the corpus luteum.

**Determination of Sex.**—An important problem in the study of the internal secretions is involved in the question of the determination of sex and the differentiation of secondary sexual characteristics. The stigmata of sex have always been regarded as dependent on the organs of generation. Primitive peoples even to the present day have considered the differences in sex as due to the influence of the external genitals, the breasts in women being also regarded as of

especial importance. The ancient students of medical science held the uterus responsible for the peculiar characteristics of woman, and the word hysteria (ὕστερος, uterus) was employed to express the unstable nervous manifestations to which the female sex is susceptible.

In more recent times the seat of femininity was transferred from the uterus to the ovaries, and the old saying of Helmont, "Propter solum uterum mulier est quod est," was changed by the Chéran to "Propter solum ovarium mulier est quod est."

The modern knowledge of the ductless glands and their influence on growth has greatly modified the old ideas, and we now know that the question of sex differentiation is not as simple as the ancient dicta implied. Virchow believed that all the peculiarities of mind and body that differentiate man and woman are dependent on the generative glands, but offered no explanation of the fact that individuals possessing the glands of one sex frequently exhibit the bodily and psychic characteristics of the other sex. Modern science has succeeded only imperfectly in solving the riddle of sex development, but enough facts are known to show that the subject is exceedingly complex and that full normal sex growth is dependent on many factors in which probably all the glands of internal secretion play an important rôle.

Theories regarding the origin of sex may be grouped under three headings:

(1) That sex distinction is predetermined in the ovum or spermatozoön.

(2) That sex is determined at or immediately after fertilization.

(3) That the sexual cells (ovum and spermatozoön) are undifferentiated at the time of fertilization and that the sex is not determined until some time during embryonic life.

Biologic investigations reveal that sex distinction may take place in all three ways. Thus in certain lower forms of life the sex of the eggs laid by the female is influenced by external conditions, such as heat, cold, and humidity. In other forms the female lays eggs of two different sizes, the larger of which produces females and the smaller males. In each of these cases it is evident that the sex is determined in the ovum.

In some forms of insects sex is determined by two kinds of spermatozoa, being dependent upon the number of chromosomes contained in the nucleus of the sperm cell. In this case the cells which contain an accessory chromosome produce females; the others, males.

Biedl quotes authorities who claim to have discovered that in mammals and in man there exist two varieties of spermatozoa which have distinct staining reactions and which may possibly represent the two sexes.

In bees, ants, and wasps, to quote Biedl, "the conditions are different, there being only one kind of egg and one kind of spermatozoön. Males are produced by parthenogenesis, females proceed from fertilized ova. The queen bee is impregnated once only, the semen being retained in the receptaculum seminis. From the eggs into which the sperm cells penetrate, females—that is, queens and

workers—are hatched, while from the unfertilized eggs, males—that is, drones—proceed. Lenhossek thinks it possible that the sperm cells find access only to those eggs which possess female characteristics and that they do not penetrate the male eggs.

These observations show that, in the lower forms of life, sex differentiation may already exist in the unfertilized egg, or it may be determined in the course of, or immediately after, fertilization.

In the higher order of mammals the factors that determine the time and nature of sex differentiation cannot be accurately noted. There is, however, evidence to show that in them the process corresponds to the third method mentioned above, by which differentiation takes place at a considerable time after fertilization during embryonic life. In man the so-called primitive genital trace remains undifferentiated until the fifth week, when it develops into a definite unisexual gland, either ovary or testis. During this preliminary period it is assumed that the primitive genital trace is potentially bisexual, or hermaphroditic, from the fact that in rare instances true hermaphroditism may occur in man; that is to say, elements of both sexes may appear in the gland of one or both sides, or even a male gland on one side and a female gland on the other. The factor which determines the development of the primitive trace into ovary or testicle is, as Biedl remarks, absolutely unknown.

The two sexes differ in other respects than in the generative glands. Most important are the excretory ducts of the glands and the genital apparatus, including the external genitals and breasts. These are rightly termed by Biedl the "secondary sexual organs," for, as we shall see, their distinctive development is dependent upon the nature of the primary genital gland. In addition to these there are other less striking though marked differences in practically all of the tissues of the body, such as skeletal details, distribution of fat and hair, formation of the larynx, consistence of the skin, muscular development, etc. The nervous and mental equipment of men and women shows a decided divergence. All those differences between the male and female exclusive of the glands of generation (ovary and testes) may be regarded as "secondary sexual characteristics."

Between the tissues of the primary and secondary characters there exists an important cellular difference. The organs of generation contain the germ cells or gametes (ovum, spermatozoön), the function of which is reproduction, that is to say, each cell is capable of reproducing a complete individual. The germ cells, therefore, possess the potential of immortality. All the cells of the body other than the germ cells are called "somatic" cells. These make up the various organs and structures of the body, and are mortal, in that they die with the individual. It is quite probable that all the somatic tissues of the body possess in males and females secondary sexual differences. To those structures in which the differences are apparent is applied the term "secondary sexual characters."

We have already seen that the sex differentiation of the primary generative cells may take place in several ways, in human beings the process occurring some time after fertilization and manifested by the development in the fifth week of a

distinctive gland (ovary or testes) from the primitive genital tract. The question then arises, Is the sex of the somatic cells predetermined in the ovum or is it determined later by the nature of the generative gland through the influence of an internal secretion? There are conflicting views on this point. According to Biedl and others the somatic tissue is primarily indifferent and does not begin to show differentiation until after the development of the generative gland. A number of facts support this view.

In the early embryo there is no sexual distinction in the secondary genital organs. The primitive Wolffian and Müllerian apparatus lie side by side communicating by a common opening. (See section on Embryology.) At the end of the third month one of these two systems begins to develop at the expense of the other, according to the nature of the (now differentiated) generative gland; the Wolffian developing if the gland is male, and the Müllerian if it is female. Whichever system gains the ascendency, there always remain rudiments of the other even in full maturity. Thus it may be said that in the earliest beginning the individual, as far as the secondary genital organs are concerned, is completely bisexual and that the ultimate sex is determined after the development and under the influence of the genital gland. The same process doubtless characterizes all the other somatic tissues besides the genital organs, for in the newborn there are numerous well-defined differences of organization in the two sexes. These secondary sex characteristics are in many ways firmly established before birth, for even after the earliest castration the male always remains distinctively a male and the female a female throughout life.

The prevailing theory at present is that the sex differentiation of the secondary genital organs and of the general secondary somatic characteristics is due to an internal secretion from the generative gland. It is also believed (chiefly as a result of the researches of Tandler and Gross) that this specific internal secretion is elaborated by the interstitial cells of the generative gland, that is, by the cells of Leydig in the testicle and by the analogous interstitial tissue in the ovary.

An apparent contradiction to this theory is the fact that frequent incongruities occur between the nature of the sex gland and that of the secondary characteristics. Thus it often happens that both the Wolffian and Müllerian systems develop more or less equally in the presence of an apparently unisexual generative gland. In other cases the secondary sex apparatus may be predominantly of the sex opposite to that of the gland. These represent the various forms of pseudohermaphroditism. In still other cases individuals with normal primary and secondary genitals may exhibit marked characteristics of the other sex. There are the masculine, hairy, deep-voiced women, and the soft, effeminate, beardless men. There are also curious cases reported in which there may take place during the life of the individual an almost complete alteration of the sexual characteristics, a result usually of some injury or disease of the genital glands.

According to Biedl, the various manifestations of hermaphroditism give evidence that the primitive genital trace from which the ovary or testes develops at the fifth week is in its primordial beginning *bisexual*, and the genital gland in

its development may retain both the male and female tissue elements that elaborate the respective internal secretions. This condition Biedl names *glandular hermaphroditism*, and calls attention to its frequency in animals even of the higher orders. Several cases of so-called "ovotestis" have been demonstrated in man.

Hence hermaphroditism is, according to this theory, the result of a bisexual internal secretory mechanism in the generative gland, and the irregular secondary sex characteristics are determined by the special activities of the two secretory tissues.

We may sum up the theory of sex differentiation as expounded by Biedl as follows:

(1) Sex differentiation may be determined in the ovum at the time of fertilization, or at a considerable time after fertilization during embryonic life. In the human race it takes place according to the last named method.

(2) The generative gland (ovary or testis) is developed from the primitive genital trace. The primitive genital trace is at first bisexual, as is shown by glandular hermaphroditism (ovitestis). The influence which directs the primitive genital trace into ovary or testis is absolutely not known.

(3) The secondary sexual characteristics including the secondary genital organs are the result of the influence of an internal secretion created by the generative gland.

(4) Incongruities between the sex of the gland and that of the secondary characters, as seen in the various forms of hermaphroditism, are presumably due to the presence in the gland of both male and female organs of internal secretion (glandular hermaphroditism).

The foregoing is interesting chiefly in demonstrating the bisexual character of the human organism in its earliest embryonic state. It does not, however, settle the question as to the predetermination of sex in the ovum or sperm cell, for it does not even suggest an explanation of the cause of the differentiation that takes place in the primitive genital trace in the fifth week, an influence which may conceivably date back to the germ cell before or at the time of fertilization.

It is quite doubtful if the determination of the secondary sexual characteristics is as simple as Biedl would have us believe, referring them as he does entirely to the influence of the internal secretion of the genital glands. Most of the ductless glands have, as we have seen, a powerful influence on growth and sexual development. The effect of tumors of the suprarenal cortex in evoking male secondary characteristics in female patients is an example suggesting that other ductless glands than the gonads may have powers of sex differentiation and that hermaphroditism may be due to irregularities in the general internal secretory system. If the ductless organs are to a greater or less extent sex glands, are they themselves sexually differentiated, and if so, is their sexuality primary or secondary in relationship to the gonads? Such questions cannot at present be answered.

## THE HYPOPHYSIS

There has been demonstrated a most intimate functional relationship between the hypophysis and the sex glands; hence the subject is of especial interest to the gynecologist.

In order to understand the various phenomena produced by the internal secretions of the hypophysis a familiarity with its anatomic structure is essential.

The hypophysis or pituitary body is situated within the cranium at the base of the brain, being surrounded by a bony encasement called the sella turcica. It is connected with the brain by the infundibulum, which passes through an opening in the dura mater lining of the sella turcica. The organ, taken as a whole is flattened anteroposteriorly and almost completely fills the cavity of the sella turcica. Its weight is approximately the same in men and in nulliparous women, but is appreciably increased in women under the influence of pregnancy.

The hypophysis consists of two parts, termed the anterior and posterior lobes, which exhibit important differences both in histologic structure and in physiologic properties. The anterior lobe, which constitutes the greater part of the organ, is kidney shaped, concave posteriorly, firm in consistency, and has a characteristic pinkish-gray color in the fresh state. It is epithelial and glandular in structure. The posterior lobe lying in the concavity of the anterior is smaller in size, rounded in contour, of a soft consistency, and white in appearance. Its structure is composed of nervous elements. Thus the two lobes are often spoken of as the *glandular* and *nervous* parts of the hypophysis.

Encasing the posterior lobe is an epithelial lining which extends upward along the infundibulum. This structure is designated the *pars intermedia* and probably belongs essentially to the posterior lobe, with which it forms an important physiologic association in the elaboration of a specific secretion.

*Histologically* the anterior lobe is composed of two fundamentally distinct types of epithelial cells, characterized by their difference in affinity for certain stains. These cells in consequence of their staining reaction are termed chromophils and chromophobes.

The chromophils have a definite outline with a homogeneous protoplasm which is full of fine secretion granules. These cells stain intensely with acid or basic stains, hence their name.

The chromophobes, on the other hand, are ill-defined in outline; they do not contain secretion granules, and have no special affinity for acid or basic stains. The chromophobes are also termed the chief cells (Hauptzellen).

The posterior lobe, or nervous part of the hypophysis, consists of a loose stroma made up of connective-tissue elements and neuroglia in which the latter is in excess. It is invested with the epithelial *pars intermedia*, with which, according to recent theories, it is structurally connected.

*Clinically*, changes in the anterior lobe produce characteristic reactions in the general organism, as is exemplified by such diseases as giantism and acromegaly. The functional activity of the anterior lobe is closely interrelated with

that of the sex glands. Extracts of the anterior lobe exercise a definite influence on the sexual apparatus. Extracts of the posterior lobe have a specific action on certain unstriped muscular systems, including the uterus.

The interrelationship between the hypophysis and the genitalia has been clearly established by both experimental and clinical evidence. The earlier experiments, carried out notably by Cushing, Biedl, and Aschner, demonstrated that deficiency of the anterior lobe secretion created artificially by partial removal of the organ produced genital atrophy in adult animals, while in unmatured animals it brought about a condition of permanent genital infantilism.

Cushing found in animals from whom the anterior lobe of the hypophysis had been removed a characteristic picture. The animals grew very fat, the genital organs of adult animals becoming atrophied, and those of young animals remaining undeveloped and infantile in type. In time there ensued polyuria and glycosuria, falling out of the hair, subnormal temperature, and lessened resistance to infectious diseases.

Aschner's experiments consisted of total and partial extirpations of the gland in dogs before and after sexual maturity, with the purpose of noting the anatomic changes in the reproductive organs. The operations on the hypophysis were made by the oral route, through the soft palate and cuneiform bone. The dogs which had been operated on before sexual maturity were allowed to live until several months after the time of normal maturity, and were then compared with normal control dogs of the same litter. The experimental animals showed the characteristic outward disturbances of development described by Cushing, manifested by retarded skeletal growth, accumulation of fat, and general infantilism of the various organs, the internal genital apparatus being small and underdeveloped. Histologic examination of the ovaries showed retarded and incomplete ripening of the follicles and a special tendency to cystic degeneration. The uterus remained hypoplastic and infantile in character. Heat appeared later in these dogs than in the normal, and only in rudimentary degree, with slight appearances of hyperemia and uterine secretion. There was invariably sterility and only faint manifestation of sexual impulse.

Extirpation of the hypophysis in mature animals showed less marked changes in the genital organs. A moderate amount of degeneration was observed in the ovaries, while the uterus showed very much less atrophic change than is seen after castration. Heat was not entirely destroyed, but was considerably weakened.

The effect of removal of the hypophysis on pregnancy was carefully studied. In order to remove the element of operative shock the operations on gravid animals were performed in two stages, the first consisting of opening through the bone and baring the dura, while in the second the gland was extirpated. Abortion invariably followed the second stage of the operation.

Aschner finds less marked changes in the genital organs after his operations of extirpation than did Cushing and Biedl after partial removal. Aschner claims that the difference is due to the fact that by his special technic less injury is done to the brain substance than by Cushing's intracranial method, and calls attention to the fact that lesions of various portions of the brain, cerebellum, and spinal cord may produce results in the genital system similar to those caused by extirpation of the hypophysis.

Further experimental evidence of the relationship between the hypophysis and the genital system has been afforded by the physiologic effects of various extracts of the hypophysis. Most of the earlier experiments were made with extracts of the posterior lobe. It was successively discovered that these extracts exercise a stimulating action on the musculature of the uterus, the bladder, and the intestines. Later they were found to possess a definite galactagogue influence,

acting either as a specific stimulant to the secreting mammary cells or as a constrictor of the smooth muscle-fibers surrounding the milk ducts.

The most interesting experiments bearing on the subject have been recently published by Goetsch, who studied the effects of overstimulation with anterior lobe pituitary extracts on the development and activity of the sex glands. In view of the retardation of genital growth produced by partial extirpation of the anterior lobe Goetsch reasoned that it might be possible to create premature sexual development by the prolonged daily feeding of anterior lobe extracts to young animals. The following quotation from Goetsch's article summarizes the results of his experiments:

"In comparison with the development in control animals the ovaries, tubes, and cornua of the uterus of animals fed with whole gland extract (in which the anterior lobe is the responsible factor) are larger, more vascular, and edematous in appearance, indicating increased development and activity. Even at the early age of two and two-fifths months, from one to two months before normal sexual maturity, the ovary is matured, and shows active ovulation and Graafian follicle formation, relatively few primordial follicles, and some increase in the amount of interstitial tissue. This striking appearance in so young an animal gives the impression that an early ovarian maturity has been produced by the feeding of the pituitary extract. The fimbriated end of the tube is more branched and the lining columnar cells are more ciliated, an indication of greater activity. There is marked hyperplasia of the uterine mucosa, the lining cells of which are more uniformly ciliated and active, and there is abundant gland formation in the endometrium. The appearance presented by the latter strikingly resembles in microscopic appearance the hyperplastic endometrium of early pregnancy. There is generally increased vascularity produced in the whole sexual system. The overdevelopment is apparent even in the muscle coat of the uterus, which is considerably thickened and is also more vascular. A somewhat similar change is produced by the feeding of corpus luteum to the female, but not to the same degree as after anterior lobe administration.

"And, again, the feeding of pituitary anterior lobe extract to rats over prolonged periods was studied with the following results: After prolonged feeding of anterior lobe extract, over a period of eight or nine months, the sexual instincts are early awakened, along with the early maturity of the sex glands. As a result of this, a pair of rats, after anterior lobe feeding over a number of months, bred earlier and oftener, the female of this pair having two pregnancies in seven months as compared with none in the female of the control pair. The effect of the anterior lobe feeding lasts through the adult life of the animals. The control rat never reaches the degree of development and activity shown by the animal receiving the anterior lobe extract. For even at the age of ten months, after eight and a half months of anterior lobe feeding, the latter still shows a greater, more active, and mature sexual development than the control.

"The feeding of pituitary anterior lobe to parent rats exerts its stimulating influence upon the offspring in intra-uterine life and during lactation, and, when the experiment is carried further and the feeding to the young is continued after weaning, it has an even greater stimulating effect upon growth, weight and development, and causes earlier and more frequent breeding, and an increased number of offspring in the litters. The stimulating effect upon the sex gland is greater, the longer the influence of anterior lobe administration is exerted.

"The extract of pituitary posterior lobe, even after prolonged administration, does not stimulate growth in general, nor the development of the sex glands, as does anterior lobe even after a very short period. Thus, for example, there is a much less marked development of the sex glands after administration for two and a half months. The posterior lobe element in the whole gland extract has an undoubted retarding influence upon the development of the sex glands, an effect very similar to that of ovarian extract upon the testes. This is shown by the relatively incomplete development of the testes, for example, after eight and a half months of posterior lobe feeding. If given in too large doses the extract causes in the rats loss of weight, a mild enteritis, and increased intestinal peristalsis."

Clinically the reciprocal action between hypophysis and sex glands is manifested in numerous ways. Very striking is the influence of pregnancy on the size and weight of the hypophysis. Erdheim and Stumme made a systematic study of the hypophyses of women who had died during pregnancy, and proved that the gland always becomes hypertrophied during the pregnant state. They showed that the hypertrophy takes place only in the anterior lobe and that the posterior lobe not only does not share in the overgrowth, but actually suffers a certain amount of compression.

On section the gland is lighter in color, is softer, and on pressure exudes a milky juice. This change in consistency is the result of a surprising change in the cellular elements of the anterior lobe. It is found that the chromophobe or principal cells have been transformed into an entirely new cellular type called pregnancy cells, large in size and accumulated in enormous numbers. They are arranged in broad columns and alveoli and at the height of pregnancy may assume the appearance of adenomatous hyperplasia. Cases have occurred in which the hypertrophy of the gland has been so great as to exert pressure on the optic chiasm with resultant bitemporal hemianopsia (Goetsch). The acromegaly-like changes in the face and extremities that occasionally appear in pregnant women are thought to be due to hypertrophy of the anterior lobe of the hypophysis. After birth of the child the gland undergoes involution in a few months, though the number of chief cells or chromophobes remains permantly increased. At succeeding pregnancies the reaction is intensified and after repeated pregnancies there may take place a form of strumous degeneration with symptoms of hypophyseal deficiency.

The author recalls two cases in which apparently changes in the hypophysis became pathologic. In the first case a young woman after her first and only child became permanently amenorrheic. Though previously thin, she began soon after the birth of her child to accumulate fat enormously, so that in time she had the appearance characteristic of dystrophia adiposogenitalis, the result doubtless of pressure on the posterior lobe of the hypophysis. The breasts became completely and permanently atrophied. At the age of about thirty-five she developed a cancer of the body of the uterus, a disease which commonly does not appear until after the menopause.

The second case was one of a woman who after bearing several children ceased to menstruate at about the age of thirty-five. There ensued an increase of fat and partial atrophy of the genitals. Attention was called to a probable pituitary change by the typical acromegaloid appearance of the hands, which the patient said had assumed this character after the birth of her last child.

The removal of the sex glands produces definite changes in the hypophysis. Fichera first described an enlargement and hyperfunction of the organ after the castration of numerous species of animals, and called attention to an increase of chromophils in the cells of the anterior lobe. Tandler and Gross demonstrated the same reaction in human beings. It was shown that eunuchs usually possess an enlarged sella turcica due to hypertrophy of the hypophysis, and it was pointed out that the skeletal peculiarities of the early castrate resemble in general

those seen in the disease giantism. The distrophic deposition of fat and the anomalies of skin and hair seen in eunuchs recall appearances characteristic of certain forms of pituitary disease.

Tandler has demonstrated an enlargement of the hypophysis in castrated women.

It has already been suggested that the hypophysis is, to a certain extent, a sexual organ. It is readily conceivable that after the removal of the sex glands in maturity the internal secretory function of stimulating the libido is carried on by the hypophysis. It is quite possible that the compensatory hypertrophy of the anterior lobe is nature's provision for carrying out this purpose. Support is lent to this idea by the increase of the sexual impulse that often follows late castration, a fact that may be explained by overstimulation from the hypertrophied sex elements of the anterior lobe.

The relation of the ovaries to the hypophysis is well illustrated by the case reported by Goldstein of a woman who in her youth had shown some tendency to giantism. At the age of thirty-eight she was subjected to a panhysterectomy for myomatous uterus. Soon after the operation she developed a very marked case of acromegaly. In this instance the influence of the ovaries had held in check the strong tendencies of the hypophyseal secretion. When the neutralizing effect of the ovaries was removed the abnormal tendency of the hypophysis was manifested by the development of acromegaly.

The influence exerted on the sexual glands by changes in the hypophysis is manifested through the effects of increased or diminished function of the gland. Hyperfunction, technically termed *hyperpituitarism*, is due to increased activity of the anterior lobe consequent upon adenomatous enlargement or hyperplasia of that portion of the gland. The increased secretory activity is referable to the chromophil cells which may be regarded as primarily the sexual elements of the pituitary organ. If under the influence of a diseased condition hyperplasia of the anterior lobe occurs before puberty, the ultimate result is gigantism. If the hyperplasia takes place after maturity, acromegaly ensues.

During the early hyperactive stage of these diseases there takes place an active stimulation of certain of the other organs of internal secretion, notably the sex glands. Thus in giants there may be a precocious acquisition of sexual power and secondary sex characters, attended with abnormal muscular strength. Acromegalics during the early stages may exhibit a great accentuation not only of sexual vigor, but of all their intellectual and physical powers. In the course of time, however, in both gigantism and acromegaly the overactive tissue of the anterior lobe of the hypophysis undergoes a regressive change in the form of strumous tumor, with tendency to cystic degeneration. Under these conditions the once hyperfunctionating organ is transformed into one in which the function becomes deficient. A corresponding hypofunction occurs in the rest of the organism, especially in the sex glands. Men lose their libido sexualis and become impotent, while women become amenorrheic and sterile. Genital atrophy eventually occurs. The ovaries of acromegalic women show atrophic changes

on the part of the Graafian follicles and interstitial tissue with absence of corpora lutea.

Hypofunction of the hypophysis, or hypopituitarism, as it is called, may occur secondarily as in gigantism and acromegaly after a period of increased activity or it may be primary. Primary hypopituitarism may be the result of certain inherent degenerative processes or more commonly the outcome of pressure either of the hypophysis itself or of a neighboring organ. If it occurs before puberty there is a retardation in skeletal growth in the form of true dwarfism in contradistinction to the condition of gigantism which follows prepubertal hyperfunction of the hypophysis. Individuals of this kind possess typical characteristics. In addition to the undersized stature there is an aplasia of both the genital and interstitial elements of the genital glands, deficient growth of hair, and the peculiar distribution of fat referred to before in conditions of dystrophia adiposo-genitalis. The reproductive organs and secondary sex characters are infantile and there is a general sluggishness of metabolism as indicated by polyuria. There may be symptoms of pressure on the optic nerve. In other words, these dwarfish individuals correspond in every physical respect to the experimental dogs of Cushing and others, in which the anterior lobe of the hypophysis has been partially extirpated.

When the condition develops after maturity similar though less marked changes appear, *i. e.*, adiposity, hypotrichosis, retrogression in the sex organs with irregularities of function and various abnormalities of metabolism.

In addition to the well-defined cases of hyper- and hypopituitarism there are cases in which the symptoms are confused as a result of a state of increased and diminished activity occurring in the same gland at the same time. To such a condition has been given the term *dyspituitarism*.

**Organotherapy.**—From a therapeutic standpoint extract of the posterior lobe (pituitrin) has proved of the greatest value, particularly in obstetrics. Although the extract has a stimulating influence on unstriped muscle generally, it seems to exert a specific action on the parturient uterus. Pituitrin acts as a powerful stimulant to uterine contractions and is, therefore, of use in accelerating labor and in preventing postpartum hemorrhages. It is rarely toxic, but it is attended with certain dangers when used in labor. It is, in general, contraindicated during the first stage of labor, the dangers being excessive pains on account of the powerful uterine contraction and rupture of the uterine wall if there is weakness of the musculature or obstruction to the labor. Another danger is asphyxiation of the child in cases where subsequent rapid delivery cannot be carried out. Pituitrin produces a sudden and somewhat prolonged rise in blood-pressure and in some cases this may prove dangerous to the patient. The extract is most useful during the second stage of labor, in cases in which normal progress of labor has stopped. By its use many low forceps operations are avoided, while in many cases in which high forceps would ordinarily be necessary, delivery is brought about by a simple low forceps operation.

In the postpartum hemorrhage pituitrin has not taken the place of ergot. Williams recommends its use in conjunction with ergot. It acts more rapidly than ergot, but its effects are more transient; hence the best effects may be procured by administering pituitrin first and following it later with ergot.

Williams also recommends pituitrin as a prophylactic against hemorrhage in cesarean section. It is important not to administer the drug before delivery of the child on account of the danger of asphyxiation. Immediately after delivery 1 c.c. of the pituitrin is injected directly into the posterior wall of the uterus. The uterus undergoes a rapid and powerful contraction.

Pituitrin has become a useful adjunct in the treatment of intestinal paresis and distention following abdominal operations. Some even go so far as to employ it as a routine. The first dose is given from four to six hours after operation, and may be repeated a number of times at intervals of four to six hours according to indications (Goetsch). We have found it useful in a number of cases of severe distention, and in two cases it was apparently a life-saving measure.

Pituitrin is said to be valuable for stimulating the bladder in postoperative retention. In our experience it has proved disappointing when administered for this purpose. Pituitrin is usually given hypodermically in doses of 1 c.c. from sealed ampules. The injection should be intramuscular. In our experience we have never noted any toxic effects in its use for postoperative distention.

Pituitrin has been frequently advocated for the treatment of functional menorrhagias, especially in those that occur in young women. We have found it of little or no value.

Extracts of the hypophysis have been used successfully in the treatment of patients suffering from pituitary deficiency. As Cushing has pointed out, in most of these cases both lobes are affected. The loss of libido and potentia in the male and amenorrhea and sterility in the female, which are characteristic of hypophyseal disease, are, as we have seen, referable to disturbances of the anterior lobe, while the accumulation of fat and metabolic irregularities are the result of defects in the posterior lobe. Cushing and his school, therefore, recommend for the treatment of these cases extracts made from both lobes of the gland.

In gynecologic practice extracts of the whole gland are indicated in menstrual disorders that are essentially the result of pituitary deficiency, in which cases ovarian therapy may be used in combination. Goetsch calls attention in hypophyseal therapy to the importance of constant and long-continued treatment with increasing dosage for successful result. He recommends beginning with 5 grains of the dried extract of the whole gland three times daily and increasing this dosage until improvement is noted.

## THE THYROID

The variations in size of the thyroid gland during certain phases of the female sexual life has been observed since the earliest times, but only recently has the subject been put on a scientific basis by exact clinical observations and animal experimentation.

It has been observed that at puberty the thyroid at times takes on a marked enlargement, which is much more intensive and much more common in girls than in boys, and it has been suggested that many of the puberty symptoms in girls, such as tendency to heart palpitation and the evidences of vasomotor disturbances, may be due to a hypersecretion of the gland at this period.

Experiments have shown a certain antagonism between the ovaries and the thyroid gland. Animals that have been castrated early exhibit an abnormal length of certain bones, especially the tibia, while in animals from which the thyroid has been extirpated these same bones are excessively short. The early extirpation of the thyroid produces a certain amount of degenerative change in the ovaries or testicles, delays the time of puberty, and greatly limits the productivity of the individual.

It has been well established that the thyroid swells during menstruation, a phenomenon that has long been observed, and as proof that this is not due to hyperemia is adduced the fact that sometimes these menstrual swellings are the starting-point of permanent goiters.

Women with diseased thyroids usually have menstrual disorders. Kocher has observed that patients on whom a too radical goiter extirpation has been performed suffer from menorrhagia, and has treated such cases successfully with thyroid extract. He terms this condition *menorrhagia thyreopriva*. That the relationship between thyroid and genitals is not understood is shown by the fact that in some cases of hypothyroidism, or myxedema, there is amenorrhea, and that thyroid extract works beneficially for the conditions both of menorrhagia and amenorrhea when the gland is diseased.

Interesting clinical observations have been made which seem to show some definite connection between thyroidism and menstruation. Klokow reports the case of a seventeen-year-old girl who, whenever her menses were delayed, always developed a goiter, which immediately vanished as soon as the period appeared. Steinberger reports the case of a girl of sixteen who suddenly ceased flowing during one of her periods and at the same time developed a goiter. Treatment with iodin caused the goiter to disappear, whereupon the menstrual flow was resumed.

The swelling of the thyroid gland is most noticeable during pregnancy, H. W. Freund having demonstrated it in 45 out of 50 cases. Lange regards the process as a physiologic one, and considers it due to hypertrophy rather than to hyperemia of the organ, because of its amenability to iodin treatment.

Lange also made the interesting observation that women in whom the thyroid does not swell exhibit a renal albuminuria, and expressed the belief that the swelling of the thyroid acts as a protection against certain poisons which are set free as a result of pregnancy, and which, without the protection of the secretion from the hypertrophied thyroid, are injurious to the kidneys. As a rule, the enlargement of the thyroid gland gradually disappears after the end of pregnancy, but not a few cases have been reported in which a permanently increasing goiter dated from a pregnancy.

The thyroid swelling of pregnancy is ordinarily only very moderate, but

several cases are cited in the literature by Novak where the goiter became so large as to threaten the patient's life, necessitating either a tracheotomy or artificial interruption of the pregnancy. During labor the thyroid is said to take on a still greater enlargement, which in a few cases has resulted in extreme dyspnea and death. The swelling of the gland gradually recedes after labor, though it has been observed to be maintained to some extent through the lactation period.

That the thyroid may be influenced by sexual activity is shown by reported cases of swelling of the gland in women who have indulged in abnormally frequent coitus, and in whom the swelling has subsided after a period of continence.

The influence of the climacteric on the thyroid gland is little known, and the subject is largely a matter of speculation. Several instances of Graves' disease have occurred at the climacteric, and have led to the suggestion that the neuropathic and vasomotor symptoms of the change of life are the result of hyperactivity of the thyroid gland.

The relationship between myomatous uteri and thyroid diseases was first remarked by W. Freund in a paper written in 1891. Many interesting observations have been made on this subject, but the relationship cannot be very constant, as a coincidence of the two conditions is certainly not particularly common.

Glaessner reports the case of a woman suffering from myoma and Graves' disease in whom both diseases disappeared at the climacteric, while Fränkel cured a myoma and a goiter at the same time by the use of the *x*-rays. Fränkel explains both these cases on the theory that both cures were due to the injury to the ovaries.

The most recent theory connecting uterine myomata with the thyroid gland is that of Neu, who attempts to account for the heart lesions so often found in long-standing fibroid cases, a condition which he styles the "myomherz." This myoma heart he regards as due to the effect on the heart of the thyroid disturbance with which myomata are sometimes associated.

**Hyperthyroidism.**—Basedow's disease is about eight times as common in women as it is in men, and occurs chiefly during the sexual period of life. It is usually associated with a certain amount of atrophy of the genital organs, which is often manifested by amenorrhea and a tendency to sterility. Sterility, however, is by no means constant, and when impregnation does occur it usually has a deleterious effect on the diseased thyroid. A few cases have been reported in which an intercurrent pregnancy has exerted a favorable influence on the disease, but *the general experience is to the contrary.*

Exophthalmic goiter is frequently seen associated with gynecologic disease, such as misplacements, pelvic inflammation, etc., and the question of operation is a most important one. It may be said that the disease is sometimes made worse by the shock of a surgical operation, and that, therefore, operative measures should only be undertaken in cases of necessity, or when it is obvious that the thyroid disease is being distinctly aggravated by the pelvic lesion.

In one case in the author's experience in which there had been severe dysmenorrhea both the patient's general condition and the thyroid disease were distinctly improved by the operation; in another case Graves' disease was not discovered until after the operation, which unquestionably aggravated the disease to such an extent as to make it definitely noticeable.

To persons suffering from exophthalmic goiter the question of marriage and reproduction is an important one. It is necessary to take into consideration the undoubted fact that either the tendency to the disease or allied neurotic conditions may be transmitted by heredity, while the danger of aggravating the disease by pregnancy is a matter of moment.

**Hypothyroidism (Myxedema, Cretinism** [Novak]).—Our knowledge of the resulting conditions of hypothyroidism is gained from animal experimentation, operations on human beings for goiter, and the clinical effects of absence or destructive disease of the thyroid gland.

Removal of the thyroid of young animals produces constant and characteristic appearances, consisting of an immediate limitation of growth, especially of the long bones, changes in the growth of the hair, lowering of the temperature, thickening of the skin, atheromatous changes of the aorta, genital hypoplasia, sterility, and idiocy (v. Eiselsberg).

In older animals the changes are somewhat less marked and are characterized by apathy, disturbances of the skin and digestion, emaciation, anemia, and lowered resistance to disease. The genital functions are diminished, but not always entirely destroyed.

These experimental results in animals correspond very closely to the effects of thyroid removal in man, when all the gland structure (excluding the parathyroid) has been extirpated. The condition has been termed "cachexia strumipriva" (Kocher) and "postoperative myxedema." In the young complete removal brings about changes similar to those described in animals, sexual development being either entirely prevented or much delayed.

Congenital myxedema or thyreaplasia relates to a condition where there is entire absence of the gland. The picture is characteristic and familiar—dwarfism, cretinic facies, peculiar thick, dry skin, broad nose, wide nostrils, and thick lips. There is very marked hypoplasia of the genital organs and mental defectiveness. This condition is said to be hereditary, being influenced by blood relationship or alcoholism of the parents. The disease does not make its appearance until the second half of the first year, it being supposed that in uterine life and during the lactation period the child receives thyroid secretion from its mother.

Infantile myxedema is the result of an early atrophy of the thyroid gland in children who are born normal, and remain so until the fifth or sixth year, when they acquire the myxedematous condition. The disease is far more common among girls than boys. The genital system at puberty remains in the infantile stage. The other appearances of hypothyroidism are like those of congenital myxedema, only not as severe.

Myxedema of adults is more common than the infantile type and is seen especially in certain countries. It is the result of atrophy of the thyroid gland from either a simple or inflammatory process. The disease is characterized by dryness, thickness, and coolness of the skin, which shows swellings, especially of the face, neck, and extremities. The hands look plump and short, the eyelids hang down, and the upper lip is thick and protruding. The patient becomes apathetic and indolent. The speech is slow and expressionless. Sweat secretion entirely ceases. The blood is reduced in red corpuscles and hemoglobin (Novak).

The etiology of adult myxedema is not definitely known. Heredity seems to play a certain rôle, as shown by examples where it has appeared in several members of the same family.

The disease is found chiefly in women, the proportion being estimated as high as 80 per cent. In a very large number of cases there are found pelvic disturbances, which, however, are probably rather the result than the cause of the disease. Severe intrapartum bleeding and too frequent childbearing have been assigned as etiologic factors. Sometimes myxedema develops during pregnancy.

The special genital symptoms that occur with myxedema are usually in the form of menstrual disturbance, either as amenorrhea or menorrhagia, for both of which conditions thyroid extract works beneficially.[1] The disease does not always alter the genitalia, but may cause marked atrophy.

Another form of hypothyroidism is seen in the condition of endemic cretinism, in which the disease is associated with goiter and is confined to certain localities. The etiology of this affection, usually referred to drinking-water, cannot be discussed here. Hereditary influences unquestionably play some part in its transmission.

The disease manifests itself by myxedema and disturbance of genital development. As a rule, the genitals preserve the infantile type, and there is partial or complete lack of development of the secondary sexual characters, especially apparent in the breasts and pubic hair. Sometimes the genitals mature normally and the individual may procreate, but is liable to dystocia on account of narrow pelvis.

## THE PARATHYROIDS

The influence of the parathyroids on the organism has been studied experimentally in animals. It has been found that in all animals where all four parathyroids are removed death follows from acute tetany, while a partial removal of the parathyroids may or may not produce a condition of chronic tetany. The subject is of interest here in relation to the tetany of maternity, which is thought to be the result of parathyroid insufficiency. Following in line with animal

[1] The menorrhagia of myxedema is probably due to a perverted calcium metabolism which produces a diminution of the coagulability of the blood. It is therefore advisable in these cases to administer calcium in conjunction with thyroid extract (Goodall).

experiments in which, by many investigations, successful results on tetanized animals were obtained by the implantation of parathyroid tissue, von Eiselsberg has succeeded in effecting a permanent cure of recurring tetany in a woman by transplanting a parathyroid gland from a patient who was undergoing a goiter operation. The results of parathyroid extract administration in cases of tetany have so far not been particularly encouraging.

An attempt has been made to show a relationship between the parathyroids and the conditions of eclampsia and osteomalacia. Favorable results have been reported of the use of parathyroid in cases of eclampsia, but the relationship has not been scientifically proved and is a matter of doubt. The same may be said of osteomalacia.

## THE SUPRARENAL SYSTEM

A knowledge of the histology and comparative anatomy of the suprarenal system is essential for an understanding of the present theories regarding its internal secretory functions. Comparatively recent studies have shown that the suprarenal bodies, formerly regarded as homogeneous organs, in reality represent the union of two different and independent organic systems. This knowledge was gained first by the frequent discovery of small bodies isolated from the main glands which from their histologic structure could only be regarded as accessory parts of the suprarenals. Secondly, comparative anatomy showed that in the lower vertebrates the two tissues which constitute the cortex and medulla of the suprarenal glands exist as two anatomically separate systems. Furthermore, comparative embryologic studies revealed the fact that two independent systems are evolved from two separate primordial beginnings, which in the higher vertebrates become topographically united in the form of a single gland.

The cortex of the suprarenal body is originally derived from the mesoderm and is, therefore, a connective-tissue structure, a point which is of importance in considering its relationship with the glands of sex. The cells of the cortex are arranged in rows and columns. Their protoplasm is filled with fat or lipoid granules. The cortical cells resemble closely the interstitial and luteal cells of the ovary both in their general arrangement and in their possession of lipoid granules.

The medulla, on the other hand, is derived from the ectoderm and is, therefore, an epithelial structure. It has a common origin with the sympathetic nervous system from which it separates in the process of embryonic evolution. The cells of the medulla, richly supplied with nerves and vessels, are arranged in spheroid or cord-like masses. They have an affinity for chromic acid from which they receive a brownish stain; hence they are called chromaffin cells.

Thus the cells of the cortex are distinguished by their lipoid contents and the cells of the medulla by their chromaffinity.

Besides the two suprarenal capsules there are to be found isolated cell aggregations in certain parts of the body, some of which contain cortical and others

medullary tissue. Rarely cell bodies are found containing both cortical and medullary tissue, thus constituting true accessory suprarenals. The accessory cortical cell collections are found in the neighborhood of the suprarenals; in the renal substance itself; along the suprarenal veins; throughout the retroperitoneal space extending down into the pelvis; in the broad ligaments, and in the sex glands (ovary and testes). It will thus be seen that the cortical accessory bodies lie in general along the path traveled by the sex glands.

The accessory medullary cell accumulations have a definite independent distribution. Inasmuch as the medulla of the suprarenals had a common embryonic origin with the sympathetic nervous system, the accessory portions are found distributed along the sympathetic nerves and ganglia partly as isolated cells, partly as small cell bodies, and partly as glandular structures. The last named are invariably found at the bifurcation of the carotid artery and at the abdominal division of the aorta, and have received special names (carotid gland, accessory organs of Zuckerkandl). All these accumulations are made up of chromaffin cells like those of the suprarenal medulla. Hence the medulla with all its accessory elements is termed the *chromaffin system.* Thus it will be seen that the cortical portions of the suprarenal system is anatomically closely associated with the urogenital organs, while the medullary or chromaffin portions are intimately connected with the sympathetic nervous system. With this brief description of the anatomy of the suprarenal apparatus it will be easier to understand its otherwise confusing physiology.

The two systems of the suprarenal apparatus, cortical and medullary, have each an independent internal secretory function. Most of our present knowledge of the specific secretions of the two parts of the suprarenals relates to the medullary or chromaffin system, which elaborates the hormone, called *adrenalin* (or *adrenin* or *epinephrin*).

Before the discovery of the independence of the two parts that constitute the suprarenal organs the whole glands were called the adrenals, from which the word "adrenalin" was derived. In the modern scientific treatises the medulla and its accessory tissue are generally referred to as the *adrenal system.* This nomenclature is apt to create confusion in the mind of the student. In contradistinction to the *adrenal* system, the cortex and its subsidiary tissue is termed the "interrenal system." In order to prevent confusion we have purposely avoided using these terms.

The physiologic functions and chemistry of adrenalin are better known than those of any other hormone of the body. It is probably necessary to the life of the organism. Experimental extirpation of the medulla does not always cause death, but in these experiments only part of the chromaffin substance is removed, for the adrenal function is carried on by the accessory tissue which is scattered throughout the body in association with the sympathetic nerves and ganglia. These free portions of the system actually comprise collectively a mass of active functioning tissue considerably greater and more important than that part which is enclosed in the suprarenal capsules, namely, the medulla (Biedl).

Adrenalin, owing to the origin and distribution of the chromaffin tissue, has a specific affinity for the sympathetic nervous system and exclusively influences those parts of the body which are enervated by the sympathetic system. The results of its action correspond identically with those produced by electric stimulation of the sympathetic nerves supplying those organs (Biedl). Space does not permit a full discussion of the physiologic significance of the chromaffin tissue. The following brief summary of its action is taken from Falta:

"The physiologic significance of the chromaffin tissue may be adduced from what has just been said with regard to adrenalin's intensive and manifold actions. We may assume that it maintains the normal excitability of the sympathetic nerves and that by means of graduation of the secretion it is concerned in the regulation of the blood-pressure, the distribution of blood, and the tonus of all other organs innervated by the symphatetic; further, that it maintains constant the amount of sugar in the blood and enters in a regulatory manner into other factors of the metabolism; further, that it influences muscular power (whether directly or through carbohydrate metabolism is questionable); and finally it exercises an influence on the production of neutrophilic leukocytes and on the plasma contents of the circulating blood."

Of especial interest is the fact that the hormone of the chromaffin system is greatly influenced by conditions of emotional disturbance. Cannon has shown experimentally how such emotions as fear, anger, desire, etc., may powerfully affect the output of adrenalin, either by suppression or accentuation, with corresponding changes in the organs innervated by the sympathetic system. In view of the emotional lability that characterizes woman's nature especially at such critical periods as puberty, menstruation, pregnancy and the menopause, and the organic disturbances that occur at such times, there undoubtedly exists through the medium of the emotions an important relationship between the organs of generation and the internal secretion of the chromaffin system.

The following quotation from Cannon gives an excellent idea of some of the interesting work he has done on the relationship of the secretion of adrenalin to the emotions:

"When a cat becomes infuriated the pupils are dilated and the hair is erect from the neck to the end of the tail. But besides these surface manifestations there are internal changes; for example, the heart beats rapidly and the activities of the stomach and intestines are stopped. Both the internal and the external changes are due to the passage of nerve impulses to viscera along the neurons of the sympathetic division of the autonomic system. The relation of the fibers connecting the central nervous system with these neurons is such as to provide for diffuse action on all the viscera that are innervated by this division.

"The suprarenal glands are supplied with nerves from the sympathetic division; and also the secretion of the suprarenal medulla affects all structures innervated by the sympathetic division precisely as if they were being stimulated by its impulses. We have found that the suprarenal glands secrete epinephrin in times of great excitement, that there is an increased liberation of sugar from the liver so that glycosuria may result, that there is an abolition or prompt lessening of muscular fatigue, and that there is a very much more rapid clotting of blood. It is known also that epinephrin causes a redistribution of blood in the body so that it is sent away from the alimentary canal, whose activities are inhibited, to the heart, the lungs, the central nervous system, and active skeletal muscles. It is known, also, that epinephrin causes dilation of the bronchioles, and it is known that it increases the number of red

blood-corpuscles per cubic millimeter—an increase which Lamson has shown occurs also to a marked degree in case of emotional excitement.

"These changes, as true of man as of the lower animals in times of great emotional stress, are significant when the conditions which would give rise to the emotions are considered. Fear is associated with the instinct to flee; rage, with the instinct to fight These are the emotions and instincts underlying the struggle for existence. They are also the emotions and instincts into which all other instincts may be readily turned when they are thwarted. The internal changes are all directed toward increasing the efficacy of the organism for physical struggle. The increased blood-sugar provides a source of muscular energy. The altered distribution of blood and the increased number of red blood-corpuscles arrange for carrying an abundance of oxygen to the active structures. The dilated bronchioles allow ready ventilation of the lungs when oxygen is greatly needed and carbon dioxid is being produced in large amounts. The provision for lessening muscular fatigue is directly useful in muscles likely to be employed in continued action. The rapid coagulation of blood tends to preserve that precious fluid in case of injury to blood-vessels. The organism in which these changes most promptly occur has the greatest reinforcement of its abilities and is most likely to be favored in physical struggle. These arrangements for reinforcement account for the great power and endurance which are exhibited in times of intense excitement."

Of the *cortical* (or *interrenal*) part of the suprarenal system unfortunately comparatively little is known at present, although what few facts are at hand lend sufficient evidence that it bears a relationship to the sexual apparatus of considerably greater significance than does the chromaffin system.

Experiments testing the physiologic action of extracts of cortical substance have not up to the present time produced very significant results:

"R. G. and A. D. Hoskins have carried out a series of experiments on white rats in which certain of the young animals were fed with *desiccated adrenal gland* (Parke, Davis & Co.), while certain others were kept as controls. Forty-five rats were fed with adrenal body for varying periods of from nine to twelve weeks. Twenty-six animals from the same litters were kept as controls. The rate of growth and the weights of various glands were determined in each series. No differences between the two series could be detected in the case of the kidneys, heart, pituitary body, thyroid, thymus, or adrenal bodies. The spleens of the experimental series were somewhat smaller than those of the controls, but highly variable in size. The ovaries in the few cases studied were larger in the experimental series. The testes (26 experimental, 13 control) showed hypertrophy. These results indicate that the adrenal bodies exercise a stimulating effect on the growth of the testes in young animals." (Quoted from Vincent.)

A functional relationship between the sex glands and the suprarenals was first announced by Meckel, who observed that animals endowed with the strongest sexual powers are also possessed of markedly developed suprarenals. He also found macroscopic changes in both glands in birds and amphibia during the rutting period. Meckel's observations, made over one hundred years ago, have to a certain extent been confirmed by more recent researches.

Defective development of both glands is often found associated, a result, doubtless, of their original proximity in embryonal life. Negroes are distinguished by a greater development both of sex and suprarenal glands than is seen in white races, a fact which confirms in the human race the observations made by Meckel in animals.

Further evidence of the correlation between the two glands is the occasional appearance in the realm of the genitals of accessory suprarenals consisting of cortical and even chromaffin tissue. One observer has demonstrated chromaffin tissue in the ovary itself. In hypoplastic individuals with underdeveloped sex glands a diminution of the suprarenals has also been noted, though this is now thought to be not a specific result of sexual deficiency, but a part of the general hypoplastic constitution. In the condition of status thymicolymphaticus there is also associated hypoplasia of both glandular elements.

Marine emphasizes the similarity between the cells of the cortex and the interstitial cells of the ovary both as to structure and their high lipoid content, and it is now generally believed that the interstitial cells of the sex gland play an important part in the development and maintenance of the secondary sexual characters. If the two tissues are identical it is probable that the cortex also influences bodily growth. Strength is lent to this theory by the fact that both tissues reciprocate in their physiologic hyperplasias. Still further evidence that the suprarenal cortex influences growth is seen in the occurrence of cortical hyperplasia in acromegaly.

As an expression of hyperfunction of the suprarenals a number of cases of female pseudohermaphroditism have been reported combined with the presence of hypernephromata, and it is thought that there is a probable causal relationship between the two conditions.

Numerous cases of this kind have been reported. To this list is added the following, for which the author is indebted to Dr. E. A. Codman, in whose practice the case occurred:

The patient, a woman of thirty-four, had been married five years and had no children. As a girl she had always appeared more masculine than her sister. She had a hairy condition about the nipples, under the arms, and in the middle of the chest like a man. The breasts were atrophic. She had also had hair on the chin sufficient to require shaving. The genitals were hypertrophied, the clitoris looking like the penis of a boy four or five years of age. There was no abnormality of the vagina and later at operation the uterus, ovaries, and tubes were found to be normal. Her catamenia had always been peculiar. She had had a profuse watery kind of discharge as a rule, but in 1909 following a severe shock her catamenia became normal for three months. In 1915 it stopped altogether and had not appeared since.

In September, 1916, she noticed an enlargement just below the right costal border in the region of the liver. She was seen by Dr. Codman on December 19, 1916. At this time she had a very large tumor extending from the crest of the ilium upward to the right vault of the diaphragm from which it had pushed the liver over to the left side of her abdomen. The tumor had also pushed all the abdominal contents to the left side and extended a couple of inches beyond the median line and downward well below the umbilicus. It was painless, cystic in feeling, and not tender. She had no symptoms except a slight feeling of distention after meals and some loss of weight.

An operation was performed by Dr. Codman. The operation was of great magnitude, but was successful and the patient made an excellent recovery. Microscopic examination showed the tumor to be made up of cells similar to the cortical tissue of the suprarenal body. The character of the tumor was malignant.

The after-history of this case is extremely interesting in that it shows a beneficial effect on the secondary sex characters after the removal of the tumor. The following is an excerpt from a report by Dr. Codman:

"The result of the case of Mrs. W. with the adrenal tumor was extraordinarily interesting.

She returned to my hospital on September 2, 1917, with local recurrence in the scar and around the vena cava and kidney, but she had been wonderfully well since the first operation. Greatly to my surprise, I found that the secondary sexual changes had been very much improved. The hairy condition on the chest and even on the chin had been greatly reduced. Since the operation she had menstruated regularly with a normal flow for the first time in her life. The breasts, instead of being perfectly flat like a male, had developed to a moderate size, and in the upper half of the left breast was a tumor which I took to be a chronic mastitis. It was like the caked condition one sees during menstrual period in some cases. She gained 30 pounds and felt well. The hypertrophy of the genitals was much less. She stated that she had never been so well and happy in her life."

On account of the extensive recurrence a second operation was undertaken, but the disease had involved the great vessels of the abdomen to such an extent that the attempt to remove it eventuated in the death of the patient.

Hypernephromata in children produce precocious sexual development, most of the cases being in female individuals. These children show a special form of precocity, in that there is an abnormally early development of certain primary and secondary characters, such as the external genitals, pubic hair, and general bodily form without symptoms that bespeak a true function of the sexual glands, namely, menstruation or ejaculation.

In general it may be stated that clinical evidence favors the view that when cortical tumors occur in the female an accentuation of male secondary sexual characteristics develops, and simultaneously a hypoplastic condition of the internal generative organs supervenes (Vincent).

It is well established that castration is followed by a hypertrophy of the suprarenal gland, but whether this represents a compensatory process for the loss of the ovarian secretion is not definitely known. Attention has been called in this connection to the close similarity between the corpus luteum cells and those of the suprarenal cortex. There is considerable evidence that the adrenal tissue, both that of the cortex and medulla, is hypertrophied during pregnancy and probably at menstruation, a result doubtless of increase of function.

Individuals with Addison's disease frequently have a deficient genital endowment, which is regarded as a part of a general constitutional hypoplasia that predisposes to the acquisition of the disease. There are also variations in the secondary sexual characters. Addison's disease in female children, as a rule, prevents the appearance of the menses, and if it appears in adults it manifests itself by amenorrhea as one of the earliest symptoms, a matter of considerable diagnostic importance. Dysmenorrhea and menorrhagia are very rare symptoms. Individuals with Addison's disease rarely get pregnant, but if they do, abortion or premature labor are apt to occur. The effect of pregnancy on the disease is a deleterious one.

Pigmentation of Addison's disease appears most markedly on the parts about the external genitals, and may be confined to this locality. Of diagnostic interest is the fact that pelvic tumors, especially fibroids, sometimes cause pigmentation of the skin quite similar to that of Addison's disease.

## PINEAL GLAND (EPIPHYSIS)

The pineal gland, which in some animals, notably reptiles, constitutes a well-developed organ, is in man comparatively insignificant in size (1 cm. and 0.5 cm. broad). Histologically it is composed of a few glandular cell elements held together by connective tissue. At about the seventh year the organ begins a process of involution which is completed at about the age of puberty, though a small amount of glandular tissue persists throughout life. The importance of the epiphysis to the human organism is variously estimated. It is of historic interest that Renè Descartes regarded the structures as the seat of the soul. It is thought by some that it is only a "functionless vestige of what was once in earlier evolutional stages a functioning eye." That it is an organ of internal secretion has been determined chiefly from clinical evidence and it is now generally accepted that the organ exercises a greater or less influence on the bodily and mental development of the individual and upon certain nutritional tissues. To the clinical evidence that the epiphysis is an endocrine gland has been recently added confirmative proof from observations on the growth of young animals under the influence of pineal feeding, the experiments of McCord being of chief importance. Earlier deductions regarding the action of pineal secretion were made from the bodily changes created by tumors of the pineal gland in children. These growths are rare, only a few having been reported. They comprise cyst formations, gummata, and tumors of various kinds, including teratomata. They occur chiefly in males. The symptoms are both local and constitutional, the local symptoms being due to intracranial pressure and to encroachment of the tumor growth on neighboring brain structures. The constitutional symptoms are those that may be referable to disturbances in the functional activity of the pineal internal secretion. These consist in children of an abnormal increase in bodily size and of a precocious development of the sex organs. The sexual precocity is characterized by acquisition of pubic and general body hair, and in boys by a change in voice. The genitalia and secondary characters of a boy of five and a half years may correspond to those of puberty, as in a case of von Frankl-Hochwart. There is also usually a precocious psychic development evidenced by prematurity of thought. As the disease progresses and the gland becomes completely destroyed cachexia, decubitus, etc., ensue.

When the disease occurs late in childhood or during adolescence or after maturity it is characterized by excessive obesity. According to Marburg, hypopinealism leads to sexual precocity, hyperpinealism to general obesity, and apinealism to cachexia. Biedl calls attention to the fact that there must exist an antagonism between the pituitary and pineal glands, for, as we have seen, pituitary insufficiency inhibits sexual development. Falta emphasizes the similarity in sexual precocity that exists between the constitutional effects of tumors of the pineal gland and hyperplasias of the suprarenal cortex. He thinks it possible that the trophic disturbances of the pineal glandular tumors influence the cortical system and cites a case in which hyperplasia of the cortex was found at autopsy.

Experimental evidence regarding the internal secretory action of the epiphysis is meager and somewhat contradictory. Conclusions from extirpation of the gland are at variance. Dandy's experiments led to the inference that the pineal gland is not essential to life and that it has no active endocrine function of importance to the animal's well-being. His conclusions coincide with those of earlier investigators. The more recent investigations of Horrax, however, developed that pinealectomized male guinea-pigs exhibit a premature sexual development, while females show a tendency to earlier breeding. Horrax's results are in keeping with those of C. Foa, who found after extirpation of the epiphysis in young fowls a very marked precocious development of the testes and some of the secondary sexual characteristics.

The clinical and experimental observations thus far described lead to the inference that the pineal gland secretes a substance which in early life before involution of the organ inhibits sexual development, and that such development is encouraged by conditions of hypopinealism. It would, therefore, be expected that the administration of pineal extracts would act as a deterrent to sexual maturity. Such, however, is not the case, as is shown by the experiments of McCord, which furnish one of the curious incongruences frequently seen in the study of the endocrine glands. In a recently published article McCord reports an extraordinary premature increase in the testes of young male guinea-pigs and an earlier sexual maturity in the females after pineal feeding. Administration of pineal substance to tadpoles produced accelerated growth. In unicellular organisms (paramecia) it increased the rate of production to more than double the normal, and in larval forms (ranidæ) it hastened both growth and the differentiation of specific organs.

## THYMUS

A relationship between the genital system and the thymus has long been observed in the involution of the thymus that normally takes place at puberty. Animal experimentation has shown that castration of young animals prolongs the time of thymus involution. Other observations reveal that in individuals with hypoplastic genitals involution takes place later than normal. Status thymicus is, therefore, associated with genital deficiency. Further researches have shown that castration in the young produces no observable change in the structure of the thymus, but that castration after sexual maturity causes a definite enlargement of the parenchyma.

Extirpation of the thymus has failed to prove any reciprocal functional correlation between the thymus and the genital glands.

## UTERUS

It has been suggested that the uterus produces a toxic inner secretion, the harmful influence of which is neutralized by the presence of the ovaries. Such a theory would account for the deleterious after-effects of double oöphorectomy

operations where the uterus has been left in. The theory, however, has no scientific basis, there being no evidence nor probability of a uterine internal secretion.

## PLACENTA

In the first few days of birth are noted certain appearances that have been referred to a reaction following the loss of placental secretion, and described as analogous to the involution processes of the mother. These changes in the newborn include the swelling of the breasts, from which comes a colostrum-like secretion, and in females a hyperemia and enlargement of the uterus, which in some cases may result in a discharge very like that of menstruation (see page 18).[1]

It is thought that the placenta exercises a very important influence on the mother during pregnancy, and that after the primary decidual reaction and nidation of the ovum the various pregnancy changes are largely under placental control. We have already seen how the corpus luteum probably prepares and sensitizes the endometrium for nidation, and that in the first few weeks the life and growth of the ovum is, to a certain extent, dependent on the integrity of the corpus luteum. This duty, it is supposed, is then assumed by the placenta. That the ovaries after a certain period are of little moment in the progress of the pregnancy is shown by its uninterrupted continuance after double oöphorectomy.

That the involution process after labor is due to the removal of the placenta and not the fetus is evidenced by the persistence of pregnancy symptoms in cases of dead fetus and hydatidiform mole.

The most important recent work on the placenta as an organ of internal secretion has been done by R. T. Frank. To the above deductions, which were first expressed by Halban and later confirmed by other investigators, Frank gives his endorsement and contributes additional evidence of placental internal secretory action. In order to exclude a possible ovarian influence Frank experimented on castrated animals. He found that subcutaneous injections of emulsions or solutions of placental substance cause an enormous and rapid hyperplasia of the uterus, the weight of the uterine body sometimes reaching five to nine times that of the normal control animal. The increase takes place within six to eight days after the injection. Both the uterine musculature and mucosa share in this hyperplasia. The same reaction may be evoked in transplanted portions of the uterus. Furthermore, the action is not changed by the removal of the suprarenals, pancreas, or thyroid, or by the combined removal of the suprarenals and thyroid.

A similarly rapid and pronounced hyperplasia is produced in the breasts of rabbits after placental injection, and if the stimulus is prolonged colostrum can be expressed.

Frank found, in agreement with Herrmann, that "the active principles ob-

[1] This last phenomenon may be the result of maternal ovarian secretion exerted through the medium of the placenta.

tained from the corpus luteum and from the placenta can be extracted by identical methods, chemically have identical properties, and biologically produce identical results upon the uterus and breasts."

Frank believes in the actual complete identity of the two substances and suggests that "the placenta may act merely as a storage reservoir for the active principle elaborated by the corpus luteum during the earlier part of pregnancy," calling attention to the fact that the corpus luteum during the latter half of pregnancy is an involuting functionless organ.

## RELATIONSHIP OF GYNECOLOGY TO THE MAMMARY GLANDS

The relationship between the breasts and the genital organs is very definite, but little understood.

The female breasts develop rapidly at the time of puberty. In many cases they become enlarged at the menstrual periods, while during pregnancy the hypertrophy is of a marked degree. At the menopause the breasts atrophy. In what way does the cycle of development and function of the breasts depend on the function of the genital organs?

The old theory that there exists between the mammary glands and the genital organs a specific nerve connection has been exploded as a result of more recent experiments. Galtz and Ewald were able to remove a large part of the spinal cord of a bitch without interfering with normal birth and secretion of milk in the breasts with ability to suckle the young. Similar observations have been made in women who, notwithstanding a complete fracture of the back, have been able to continue nursing their children. Pfister and Eckhardt succeeded in dividing all the afferent nerves to the mammary gland in animals without disturbing the secretion of milk, while Basch reached a similar result after extirpating the celiac ganglion of the sympathetic system.

The most spectacular experiment, showing that the function of the breasts is entirely independent of any nerve connection, was performed by Ribbert, who transplanted the breast of a pregnant rabbit on one of its ears. After the rabbit was delivered of its young the transplanted breast secreted milk.

It has further been shown that the hypoplasia of the mammary glands which usually results from the castration of young animals may be prevented by the transplantation of ovarian tissue.

From these and other experiments there seems to be no doubt that the changes in the mammary gland are due to the circulation in the blood of some chemical substance which represents a true hormone. An almost positive proof of this was demonstrated by Schauta in the case of the Siamese twins Blazek, one of whom became pregnant and bore a normal child. After the birth of the child both sisters secreted milk from their breasts. The same phenomenon has been observed by Christea in parabiotic rats and rabbits.

Although it seems to be well established that the development and function of the mammary glands is presided over by some chemical hormone, the

problem of the source of this secretion has not yet been solved. The amount of experimentation and speculation has been very extensive, but the results have been conflicting and unconvincing.

There is little doubt that the growth of the breasts at puberty, the swelling at the menstrual periods, and the atrophy at the climacteric are influenced chiefly by an ovarian secretion, since these phenomena do not appear after early castration. The hypertrophy during pregnancy and the secretion of milk after delivery seem to be due to some other factor, since both these processes continue after the removal of both ovaries during pregnancy, and, in fact, they have been shown to be dependent in some way on the *suppression* of the ovarian function. (The milk period is said to last longer after castration, while in normal women the return of the menses is accompanied by disturbances of the milk secretion.) The uterus has also been ruled out as a dominating agent in the functions of the breast during pregnancy and childbirth.

The present line of investigation is with reference to the influence of the fetus and the placenta. The experiments along this line are of great interest, but the results are inconclusive. It may be said, however, that there is evidence to show that the chemical influence of the placenta plays some unexplained part in the process, as is shown by the following experiments:

Basch injected placenta extract into virgin bitches, and found that it produced no changes in the beasts. He then implanted the ovary of a pregnant bitch in the abdominal wall of a virgin animal, and produced a hypertrophy of the breast. He next injected placental extract into this animal, and produced such an intensive secretion of milk that she was able to suckle a litter of young dogs.

This experiment suggests that the complete cycle of mammary hypertrophy and milk secretion is dependent for its full expression on both the ovary and the placenta.

There has been adduced no evidence to show that the mammæ possess an internal secretion.

Extract of mammary (mammin) has been used to some extent for the control of uterine bleeding. There seems to be no doubt that the extract does exert some specific influence on the uterus, but it is not sufficiently effective to make the extract of much practical use. Aschner reports success in 16 out of 23 cases treated for functional menorrhagia and menorrhagia due to adnexal disease, fibroids, and uterine insufficiency.

## RELATIONSHIP OF GYNECOLOGY TO THE SKIN[1]

There is an important connection between certain skin lesions and the physiologic and pathologic processes of the genital organs. The changes in the skin are seen most markedly in those periods during which the genital organs undergo special activity, namely, the age of puberty, menstruation, pregnancy, the puerperium, and the menopause. (The skin manifestations accompanying

[1] Principal authorities, Troph, Walthard, McCarthy.

pregnancy and the puerperium, though important, will be necessarily omitted in the following discussion.)

Certain pelvic diseases are also associated with skin changes, while the external genitalia are subject to well-defined dermatologic affections.

**Menstrual Changes in the Skin.**—Menstruation is preceded for several days by an increased hyperemia that is most apparent in the skin of the cheeks, the chest, and thighs. This can be seen best in individuals who are naturally pale. The hyperemia recedes during the period and is succeeded for a few days by an unusual pallor. In individuals with high color the menstrual hyperemia is less apparent, but can be recognized by observing the changes in those parts which are normally pale—around the eyes, mouth, and chin.

There are numerous skin eruptions related to the catamenial period which are classified under the term "menstrual exanthemata." The cause of these changes is not definitely known; some refer it to the influence of the ovarian secretion circulating through the system; others see a reflex or trophic disturbance in the innervation of the skin.

The clinical picture of menstrual exanthemata is extremely varied. They may be discreet or diffuse, localized or general, urticarial, vesicular, macular, papular, resembling closely the appearance of erythema exudativum multiforme, or even of erythema nodosum.

The location of the eruptions is usually on the thighs, abdomen, and breasts, but they may occur on other parts of the body. They make their appearance several days before the onset of the period, and either disappear at the cessation of the flow or last for several days after. Occasionally they break out only in the intermenstrual periods. The commonest form of these eruptions is the so-called herpes sexualis or menstruation herpes. This appears chiefly about the lips and nostrils, sometimes around the ears or eyes, occasionally on the breasts, fingers, and palms of the hands. It may also affect the mucous membrane of the mouth or the vagina and vulva, and has been described as involving the cornea of the eye.

Menstrual herpes may be accompanied by other exanthemata and even by bleeding of the skin.

Polland describes a well-defined eruption that he terms *dermatosis dysmenorrhoica symmetrica.* This is a disease which appears only in women who suffer from menstrual disturbances, chiefly dysmenorrhea. The eruption begins with hyperemia of the perifollicular vessels, followed by serous or bloody exudation and the formation of vesicles on the epidermis. Ordinarily the process extends over only a few days, but in some cases there is necrosis and ulceration, eventuating in a scar. The eruption may be almost universal over the body, but it is always symmetric. It often appears at puberty. Polland finds that the disease is benefited by ovarian extract (ovaraden triferrin) and believes that it is due to a disturbance of the internal secretion of the ovary.

Genital herpes is seen frequently in prostitutes and in individuals with great sexual irritability. Its occurrence is, however, usually closely related

to the menstrual function. A purpuric type of erythema is sometimes seen in the form of ecchymoses or petechiæ which appear several days before menstruation, and are often swollen and painful.

Another form of hemorrhagic skin lesion is that due to vicarious menstruation which may take place from the intact skin, from various mucous membranes, and from scars, wounds, and ulcers.

Acute edema is sometimes seen associated with menstruation and the climacteric, the edema occurring chiefly about the eyes, in the lower extremities, or in the external genitals. Pemphigus may occur in young girls in whom menstruation has not been regularly established or who suffer from dysmenorrhea.

Eczema is sometimes seen with various pelvic diseases, and it is thought by some that there may be a neurotic relationship between the two affections. Eczema at the time after the menopause, usually appearing on the scalp and behind the ears, occurs sufficiently often to be regarded as a specific disease under the term "climacteric eczema."

Eczema of the external genitals and surrounding parts is very frequently seen in connection with pruritus and various pelvic diseases which produce an irritating discharge. In this case the eczema is the result of chemical changes in the skin wrought by the contact of the harmful secretions.

Acne is a very common manifestation at puberty, though less frequent in girls than in boys.

In matured women who are affected with acne there is usually a distinct relationship between menstruation and the appearance of the pustules. Acne of this type is localized chiefly about the chin.

Individuals suffering from various pelvic disturbances, especially those that lead to scanty and irregular menses or to leukorrhea, seem to have a predisposition to acne.

Women at the climacteric also frequently suffer from acne eruptions.

Furunculosis of the external genitalia is sometimes seen as a chronic disease, and may be a source of great distress to the patient. The chronic or constantly recurring type is apparently a manifestation of deficiency in the function of the ovaries, by which the local resistance of the external genitals is lowered toward pyogenic organisms. That this theory is probably correct is shown by the curative effect of treatment with ovarian extract.

A certain relationship between erysipelas and the menstrual function has been established, cases having been cited in which there have been periodic attacks of erysipelas coincident with the menses.

There is a very close and well-known relationship between pigment hypertrophy and the functions of the pelvic organs. At the time of puberty there is a physiologic increase of pigment, seen especially in the skin of the external genitals, about the nipples, and along the linea alba. During pregnancy the pigment of these areas is markedly hypertrophied, while irregular spots of brown pigmentation appear on the face (chloasma gravidarum). Increase of pigmentation is often seen in individuals suffering from menstrual disturbances,

chiefly amenorrhea and dysmenorrhea. With pelvic tumors, especially the large ovarian cysts, there is often a noticeable increase of pigmentation.

Vitiligo is not infrequently seen in association with abdominal tumors, and is thought to be the result of some toxic influence issuing from the tumor. This seems a reasonable theory, as the removal of the tumor often causes a marked improvement in the appearance of the skin lesion.

**Postoperative Eruptions.**—One of the commonest skin affections encountered in gynecologic practice is the postoperative eruption popularly known by the somewhat misleading designation of "ether rash." This does not refer to the temporary erythema frequently seen during the administration of ether, which usually disappears by the time the patient recovers consciousness, but represents a well-defined disease that appears from a few hours to several days after the operation and runs a short but characteristic course. Observations of this disease are scanty and the etiology obscure. McCarthy, who has most recently studied the affection, found that in a series of 1000 consecutive operative cases at the Free Hospital for Women postoperative eruptions occurred 43 times. He divides the cases into two types, those which appear within twenty-four to forty-eight hours after the operation, and those with a later onset, the latter following a more definite course. He describes the cases with early onset as exhibiting an eruption on the upper half of the body, beginning either on the face, chest, or arms and rapidly involving the abdomen and legs. The face is affected in almost every instance. The eruption varies in character from an erythema of brief duration to a papular type lasting for several days. Itching is the most marked symptom. There is little systemic disturbance beyond a mild elevation of temperature. In the second class of cases, which have a later onset of three to seven days after operation, the appearance of the eruption is sudden without prodromata, excepting that the temperature chart has usually continued higher than is seen in the ordinary uncomplicated postoperative convalescence. The condition varies in severity, from that in which only a localized part of the body is affected to one in which almost the entire body surface is involved. The eruption begins as a fine papular efflorescence on the inner surfaces of the forearms and thighs and extending over the body, rarely including the face and never the palms and soles. There is intense troublesome itching, which persists until the eruption has disappeared. The papules are at first pink, but may later assume a dark reddish hue. The course of the disease reaches its height in twenty-four to thirty-six hours, and then rather rapidly subsides, the average duration being four days. McCarthy notes that those cases which begin on the third or fourth day after operation are of the longest duration and of greatest severity. The temperature remains slightly elevated, with little change in the pulse. There is also a moderate leukocytosis which is almost constant, and shown by control observations to be greater and more persistent than that frequently seen in uncomplicated convalescence after surgical operation.

Numerous etiologic factors have been suggested to account for postopera-

tive eruptions, the disturbance being referred to the effect of ether, calomel, magnesium sulphate, morphin, and various substances used in enemata. Some have attributed the rash to chemicals used in laundering hospital linen. Some have ascribed it to climatic conditions. Others regard the disturbance as a manifestation of mild undetected sepsis, or to the absorption of tissue destruction at the site of the wound. McCarthy has analyzed all the causes usually given, and finds that no one of them is applicable to all cases. He concludes that the affection represents a vasomotor disturbance which may be evoked from the sympathetic nervous system by a variety of exciting causes. On this theory he accounts for the greater frequency of these eruptions in women, whose nervous organism is more easily disturbed than in men. The theory also explains the greater frequency of the eruptions in a gynecologic clinic than in one devoted to general surgery, in view of the rich supply of sympathetic nerves with which the female pelvic organs are endowed.

## RELATIONSHIP OF GYNECOLOGY TO THE ORGANS OF SENSE

There exists between the organs of sense and the genitalia a relationship of considerable definiteness, the most marked manifestations being connected with the function of menstruation.

The eye may undergo various functional and pathologic changes as a result of genital influences. Vicarious menstruation following suppression of the normal function may appear in the eyes, with extravasations of blood in the conjunctiva, eye muscles, lens, choroid, retina, or even in the optic nerve. The corresponding disturbances of vision disappear with the absorption of the extravasated blood if it is small in amount. If, however, the bleeding has been profuse the condition may be followed by chronic inflammatory or degenerative processes. Even in the presence of normal menstruation from the genitalia, hemorrhages may take place in various parts of the eye and cause more or less serious disturbance.

Other pathologic processes sometimes seen in the eye induced by the influence of menstruation are eczematous changes in the lids, herpes, hordeola, inflammations of the conjunctiva and cornea, or the aggravation of already existing inflammatory conditions.

Increase of the pressure in the eye may occur, even to the extent of glaucoma.

Even with normal menstruation numerous functional disturbances may take place, such as a narrowing of the field of vision, dulness of vision, weakness of accommodation, photophobia, oculomotor paralysis, lessening of color sense, etc., disturbances which may be much more marked if the menses are abnormal. Such functional aberrations may sometimes be regarded as manifestations of psychoneuroses in nervous individuals during a period when the organism is peculiarly sensitive.

Secondary anemia from severe loss of blood from the genitals may be followed by anomalies in the eye, chiefly in the form of edema and thrombosis,

which may produce permanent degenerative processes in the retina and optic nerve. In this way bleeding tumors may affect the eye.

Malignant growths of the pelvis sometimes metastasize in the eye.

Infectious diseases of the pelvic organs may affect the eye either by direct contact with the infectious material or by embolic processes through the circulation. Of the former method, infection from gonorrheal discharges is the most familiar example. Diphtheria may also be transmitted in the same way. Metastatic infection of the eye is extremely rare excepting in connection with puerperal fever, in which it occasionally, though rarely, occurs. The embolic focus may have its seat in almost any part of the eye, but most commonly in the retina, whence it may extend to a general panophthalmia.

Puerperal sepsis sometimes causes a hemorrhage in the eye as a result of toxic changes in the blood composition and a greater permeability of the endothelial walls of the capillaries (Mayer).

**The Ear.**—What has been said regarding functional disturbance of the eye during menstruation is also applicable to the ear, *i. e.*, certain aberrations from the normal cases may be referred to the general influence on the organism of the menstrual wave, and in others to manifestations of psychoneurotic impulses which become more active during the monthly period of greater sensitiveness.

Existing chronic diseases of the ear have been observed to become permanently aggravated by pregnancy and childbirth.

**The Nose.**—Between the nose and the genital organs there exists a curious interrelationship which in some cases is quite inexplicable. The sense of smell is one of the most powerful sexual excitants. Marked changes in the nose are often seen during the menstrual period. Vicarious menstruation is more often manifested by bleeding from the nose than from any other part of the body. Individuals who menstruate normally are often prone to epistaxis during the period. During the time of puberty nose-bleeds are very common. Anomalies of secretion are often seen at the time of catamenia, and may consist either of acute nasal catarrh with profuse secretion or of abnormal dryness of the nasal mucous membrane. Disturbances in the sense of smell are sometimes observed during menstruation, evinced usually by an increase of sensitiveness or by perversions.

Nasal affections during the catamenial period are much more common in those whose menstrual function is not normal, appearing with especial frequency in women who suffer from dysmenorrhea. They are also more frequent in neurotic individuals. What was said, therefore, regarding the functional disturbances of the eye and ear applies also to the nose.

Cohabitation is sometimes attended with acute swelling and discharge from the nasal mucous membrane; sometimes with unnatural dryness of the nose and throat.

Kermauner has observed an abnormal lack of nasal secretion in those who habitually masturbate, and in the young who are addicted to this habit he recog-

nizes a characteristic expression caused by a thickening and coarsening of the nose and lips similar to that produced by certain diseases of the hypophysis.

The most striking example of the relationship between the nose and the genital organs is the influence on dysmenorrhea that can sometimes be exerted by cocainizing the nasal mucous membrane. A few drops of 20 per cent. cocain solution applied to the anterior end of the lower turbinate and the tuberculum septi (genital spot) will often, according to the best authorities, cure severe dysmenorrhea and prevent its recurrence for a considerable period of time (Fleisch, Brettauer, Meyer).

Finally, at the time of the climacteric one sometimes sees a severe intractable nasal catarrh associated with hyperesthesia of the fifth nerve. Other abnormalities mentioned by Kermauner, as occurring at the change of life, are dryness and stoppage of the nose, adenoid and polypoid growths, and eczema extending from the outer skin of the nostrils to the mucous membrane lining.

## RELATIONSHIP OF GYNECOLOGY TO THE DIGESTIVE TRACT

The relationship existing between the genital organs and the digestive tract is evident chiefly at the time of menstruation. Increased activity of the parotid glands has been repeatedly observed, so that in some cases one may speak of the condition as menstrual salivation. This phenomenon was noticed by the earlier writers, one of whom described a "vicarious salivation," which he said might take the place of the normal uterine flow. Habran described a case of periodic swelling of the parotid gland which ceased during the months of pregnancy, to be resumed again after delivery of the child. Disturbances of the mouth during menstruation have been cited, such as herpes of the lips, periodic toothache, and the vicarious bleeding from the gums.

Of especial importance is the relationship between menstruation and disturbances of the stomach, evidence of which is seen both in functional disturbances and in connection with organic disease.

The functional symptoms appear usually in the premenstrual stage and last into the menstrual period, though sometimes they cease with the onset of the bleeding. The most common symptoms of a subjective character are loss of appetite, flatulency, nausea, vomiting, taste paresthesias, aversion to certain foods, especially meat, bad breath, pains in the stomach, sensations of hunger, etc.

Symptoms of this kind are much more common in the neurotic and in those who suffer from abnormalities of menstruation, especially dysmenorrhea.

Besides these minor anomalies of the stomach, more serious disturbances may occur. Menstrual and vicarious bleeding from the gastric mucous membrane may occur, and may on some occasions constitute alarming and depleting hemorrhages. In some cases there may be severe cardialgia and symptoms simulating gastric ulcer, the differential diagnosis being very difficult. In a

case of this kind seen by the author the patient had five abdominal scars, representing as many operations performed, with the diagnosis of some serious intestinal lesion.

The influence of menstruation is definitely shown in the aggravation of organic lesions of the stomach during the monthly period. This effect is especially seen in ulcer of the stomach, which has a special disposition to bleed during the premenstrual and menstrual periods. Thus, it may be impossible to state whether monthly bleeding from the stomach is vicarious menstruation without actual stomach lesion, or whether the bleeding is from an ulcer which bleeds only when influenced by menstruation.

The cause of the influence of menstruation on the functions and conditions of the digestive tract is as little known in this connection as it is in relation to other parts of the body. Wagner sums up a discussion of the matter by saying, "Whatever the cause of the disturbances may be, two facts are indubitably established: first, the secretory and motor activity of the stomach undergoes a premenstrual and menstrual alteration; and, secondly, that this leads to symptoms according to the special disposition of the individual." Subjective gastric symptoms are not seen in all women at the time of menstruation, but they appear in a considerable percentage of them. Those specially disposed to the condition are the neurasthenic and hysteric. Some regard the dyspeptic symptoms of these patients as purely nervous reflexes, while those who accept the internal secretion theory regard neurotic patients as peculiarly susceptible to the influences of altered secretion at the menstrual period. If the condition is due to secretory changes the nature of the process is not understood. According to some, it is the direct result of an ovarian hormone circulating in the body. It would seem somewhat more reasonable and in accordance with present physiologic knowledge to suppose that the stomach changes are rather due to a disturbance of balance in the relationship of the glands of internal secretion during menstruation, and that the direct influence exerted either on the nerves of the stomach or on the stomach tissues themselves comes from some other gland than the ovary, probably the adrenals. Or, still further, it might be assumed that the gastric symptoms of menstruation may be the result of increased general nervous and emotional irritability, and that this condition produces hyperactivity of the adrenal glands with consequent influences on the secretory and motor apparatus of the stomach. This theory is in line with the well-known experiments of Cannon, who has demonstrated the effect of the emotions on the processes of digestion through stimulation of the adrenal glands.

In addition to the neurasthenic and hysteric, a predisposition to menstrual gastric disturbances is seen in the chlorotic and anemic, and still more commonly in those who suffer from congenital or acquired malpositions of the stomach. In the latter class of cases belong chiefly individuals of the hypoplastic type, with the long narrow chest walls, splanchnoptosis, pelvic misplacements, etc.

Patients with organic lesions of the stomach undergo exacerbations of their symptoms during the menstrual period in 83 per cent. of cases, according to Plonies.

A form of menstrual bleeding from the intestinal tract is that sometimes seen in patients suffering from typhoid fever. Still another instance, and one quite frequently seen, is the increased tendency of hemorrhoids to bleed at the time of menstruation.

Diarrhea is not infrequently an attendant discomfort of menstruation, one observer having found it in 49 per cent. of cases in a study of 758 women, though this figure seems rather high. Obstipation is another not uncommon symptom. Still another class of patients frequently seen suffer from chronic constipation between the periods, while during menstruation the bowels are regular or even diarrheic.

Certain digestive disturbances often characterize the menopause, such as pains in the pharynx and esophagus, nervous dyspepsia with flatulence, heartburn, vomiting, etc. (Wagner).

Diarrhea of a peculiarly obstinate nature sometimes signalizes the beginning of the change of life (Singer), and has the character of a secretion neurosis, without sign of catarrhal or inflammatory disease (Wagner).

Somewhat more common is the occurrence at the climacteric of intractable obstipation, with great tendency to gas formation. Wagner states that the constipation of the climacteric is peculiarly resistant to the usual methods of treatment. In two cases he has had good results with ovarian therapy.

Hemorrhages from the bowels are sometimes seen at the change of life. Most of the bleedings are from hemorrhoids, which at that time have a special tendency to become worse. In other cases where malignant disease has been excluded there has been demonstrated a true climacteric intestinal bleeding from the mucous membrane. It is possible that this may be analogous to the bleeding frequently seen from the vaginal mucous membrane as a result of senile atrophy.

The relationship between the genital system and the neighboring organs of the digestive tract is treated in another section. (See page 143).

The connection between pregnancy and the organs of digestion is a subject of much importance, but does not come within the sphere of this book.

The subjects of enteroptosis, intestinal bands, and diverticulitis are treated elsewhere.

## RELATIONSHIP OF GYNECOLOGY TO ORGANS OF RESPIRATION

Lung complications following gynecologic operations are comparatively frequent. Pulmonary embolism is discussed in the section on the Relationship of Gynecology to the Circulatory Apparatus.

The subject of postoperative infections of the lungs forms a very important chapter in surgical convalescence. These infections most commonly take the

form of pleurisy, bronchitis, and bronchopneumonia. Typic lobar pneumonia is rare.

As in other local infections following operation, such as phlebitis and pyelitis, etc., the causation of pulmonary inflammations is not well understood, many reasons having been suggested. Patients who develop pneumonia soon after a surgical operation are commonly said to be suffering from "ether pneumonia."[1] It is probable, as we shall see, that ether may in some cases be an exciting factor; nevertheless, that it is not the sole cause, is shown by the fact that infections of the lungs may follow operations performed under spinal anesthesia or after the gas and oxygen sequence.

There are many predisposing conditions which undoubtedly have some influence in producing the disease. Thus, surgical shock may so lower the patient's resistance as to encourage a local inflammatory process.

Old age is very distinctly favorable for lung infections. In our own series of cases the incidence of serious pneumonia was particularly noticeable in elderly women. The physical characteristics of the patient are supposed to have some influence, fat, short-necked individuals being thought to be especially prone to pulmonary complications. In our series this theory has not been borne out.

Bad behavior under ether—*i. e.*, choking, vomiting, straining, etc.—plays a certain rôle, as it is probable that such patients sometimes inhale mucus, saliva, or particles of food that may later act as foci for infection. It is probable, too, that when patients act badly under ether the necessity of forcing the ether in an irregular manner serves to irritate the lungs, and thus favors either the development of a latent infection or the active growth of newly inhaled bacteria. That a certain number of postoperative lung infections are properly called "ether pneumonias" is evidenced by the fact that they are much more common when the anesthesia is inexpertly administered. Exposure to cold while the patient is under anesthesia undoubtedly favors lung infections. The figures of all writers on the subject show a greater incidence of the disease in the winter months. There is no question that the inhalation of ether tends to stimulate latent foci of infection into activity, as is seen sometimes in the aggravation of a dormant tuberculosis into an acute form. Administering ether to a patient with a beginning bronchial cold is very dangerous. Undoubtedly, many cases of postoperative pneumonia are the result of stimulating a beginning process of infection which was not detected in the preliminary physical examination.

The nature of the operation bears some relation to pulmonary complications. Pelvic operations are less commonly followed by infections of the lungs than are operations performed in the regions near the diaphragm, and such infections when they do occur are apt to be less serious. Hernia operations and those

[1] The phrase "ether pneumonia" still in common use originated in the belief that ether acts as an irritant on the normal tissues of the respiratory tract. Rovsing proved experimentally that although ether stimulates the secretion of the salivary glands, it does not irritate the lining of the mouth, larynx, trachea, and bronchi, even in animals that are killed by administering ether through a tracheotomy tube (Darnall).

which require much handling of the gut are more prone to lung infection, as are cases in which there is active pus or septic complications after operation.

In gynecologic practice laparotomies are ten times more liable to lung complications than are plastic operations (author's figures). This is due to the fact that the reflex respiratory irritation from ether is much greater during laparotomies than in operations on the body when the abdomen is not opened, excluding, of course, operations involving the respiratory tract or nerve-centers.

Some of the pneumonias after operation, especially in old people, are of the hypostatic type.

Another cause for pneumonias following laparotomies is that the patient with an abdominal wound frequently does not dare to cough or take a deep breath, so that the lungs suffer from a lack of aëration and proper elimination of secretions.

Still another important type is that which results from the lodging of minute septic emboli in the capillaries of the lungs, the emboli usually starting from a local sepsis in the wound, which may or may not be evident. Doubtless some of the cases which begin late in the convalescence are caused in this way.

It is quite probable that some lung infections reach the lung from a septic focus from the pelvis or other parts of the abdominal cavity through the retroperitoneal lymph-spaces, in the manner of a subphrenic abscess following appendectomy.

Most postoperative lung infections do not get beyond the stage of a temporary pleurisy or bronchitis. In the more serious cases the disease becomes one of bronchopneumonia. Rarely pulmonary abscess or empyema may develop.

In gynecologic practice the mortality from postoperative pneumonia is not very great. In a series of 4000 consecutive gynecologic operations performed at the Brookline Free Hospital, reported by the author in 1910, there were 2 deaths from pneumonia.

During menstruation the vocal cords undergo a physiologic change which results in slight alterations of the voice. This is a matter of considerable importance to professional singers, some of whom are obliged to refrain from using the voice at the time of menstruation.

Chronic diseases of the lungs, especially of tuberculous nature, are, as a rule, made worse by menstruation and pregnancy. Menstruation also exerts an unfavorable influence on the course of the more acute pulmonary infections of bronchitis, pneumonia, and pleurisy. In tuberculosis of the lungs there is at the time of menstruation a special tendency to sweating, catarrh, and headache. The temperature is apt to be more elevated and hemorrhages from the lungs are more likely to occur. Hemoptysis at this time is often erroneously regarded as vicarious menstruation.

On the other hand, chronic lung tuberculosis is often attended with amenorrhea, which, as Walthard has pointed out, is not necessarily accompanied with atrophy of the uterus.

In amenorrhea with hypoplastic or atrophic genitalia true vicarious menstruation from the lungs is sometimes seen.

Acute infections of the lungs may metastasize in the genital organs through the circulation. Of the various infective organisms that attack the lungs, the pneumococcus is the most prone to cause secondary infections in the pelvis. It has been demonstrated in the purulent contents of ovarian cysts in para- and perimetritic exudates and in the contents of pus-tubes (Walthard, Scudder). It is an especially common excitant of peritonitis in children. Genital and peritoneal tuberculosis is probably, in the majority of cases, derived primarily from old or latent foci in the lungs.

Septic processes and malignant growths of the pelvic organs may by entrance into the large veins metastasize in the lungs, as is seen, for example, in the early involvement of the lungs of chorio-epithelioma.

Dyspnea, by interference with the diaphragm, is the frequent result of the large pelvic tumors, especially those which have metastasized in the peritoneum and those which are associated with ascites.

## RELATIONSHIP OF GYNECOLOGY TO THE BLOOD[1]

**Menstruation.**—The non-coagulability of menstrual blood has long been a subject of study and speculation, but has not yet been fully explained. Present evidence tends to show that the phenomenon is not a part of a general physiologic change in the blood, for the most recent experiments have proved that the blood in the general circulation exhibits no difference in the time of clotting at the menstrual period (Hartmann, Cristea, Denk, *et al*). It is now accepted that the chemical influence which prevents coagulation of menstrual blood is localized in the uterus, but just what the active substance is is not known. The experiments of Schickele seem to indicate that it is manufactured in the endometrium under the stimulation of the ovarian secretions. (See also page 58).

Studies of the blood from the general circulation in menstruating women have shown certain characteristic changes. During the premenstrual period there is an increase in the red corpuscular elements of 1,000,000 or 1,500,000, which usually, just before the onset of the period, sinks to the normal level and even below it. The hemoglobin content exhibits a periodic rise and fall, though not entirely parallel with the variations of the red elements. At the beginning of menstruation can usually be demonstrated a moderate leukocytosis which undergoes a marked fall during the bleeding. In the premenstrual period there is diminished alkalescence of the blood and a lower specific gravity. More recent investigations (Neumann and Herrmann, *et al*) have shown periodic variations in the lipoid content of the blood. All these changes are not to be accounted for by the physiologic loss of blood, which under normal conditions is too slight to create so definite an alteration. They bespeak rather

[1] Chief authorities, Adolf Payer, M. Walthard.

a periodic toxemia, which is evidenced not only by the blood-picture, but by marked general effect on the physical and nervous organism (Adolf Payer).

The nature of the circulating toxin, as is elsewhere frequently mentioned, is to be sought either in an ovarian hormone or in the products of one or more other internal secretory glands, the balance of whose activity is disturbed by the monthly change in the function of the ovaries.

**Chlorosis** is a disease of young girlhood occurring at or soon after the period of puberty, and having a tendency to recur later in life. Although there is no pathognomonic blood-picture, the typical case is characterized by a marked decrease in the hemoglobin content without corresponding diminution in the red blood-corpuscles. Thus, in a case of average severity, the hemoglobin may register 50 to 60 per cent., while the red count remains normal. If, however, the hemoglobin becomes much reduced, as it may, to 30, 20, or even 10 per cent., the red count also falls very low.

A special characteristic of the blood is its increased coagulability and its tendency to thrombosis (Payer).

The relationship between chlorosis and the genital system is one which has attracted considerable attention. Virchow distinguished a monorrhagic and an amenorrheic form of the disease, of which the latter is by far the more common. He and others after him attempted to trace a causal relationship between chlorosis and hypoplasia of the genitals, Virchow regarding the retarded genital development as secondary to hypoplasia of the circulatory apparatus. It is apparent, however, that the occurrence of genital hypoplasia in connection with chlorosis is not as common as formerly supposed, as is shown by the following figures of Otten (quoted from Opitz-Menge):

In a study by Otten of 448 chlorotic patients, 186 cases, which included the majority of the severest cases with hemoglobin under 50 per cent., there was found not the slightest disturbance of the genital functions. Among the remaining 262 chlorotic girls and women were found symptoms of delayed menarche, oligomenorrhea, amenorrhea, and in a few instances menorrhagia. Dysmenorrhea was seen chiefly among those living in wretched surroundings. Some cases of hypoplasia were seen, but in such small numbers that Otten could draw no conclusions as to an etiologic relationship between chlorosis and lack of genital development.

It is evident that dysmenorrhea is a common symptom in connection with chlorosis. A number of authors regard chlorosis not as a primary disease, but as secondary to a beginning or latent tuberculosis, and ascribe many of the symptoms characteristic of chlorosis, such as headache, dizziness, palpitation, sleeplessness, indigestion, languor, etc., to the result of a tubercular toxin (Payer). It is probable that latent tuberculosis, though not being the sole cause of chlorosis, should be regarded as an important element in its etiology.

**Hemophilia** was until recent times believed to be transmitted by inheritance to males only, though it might be inherited through an intermediate female ancestor who herself did not suffer from the disease. It is now known that women may be subject to the affection, but not as commonly as men. Two forms, called the familial and the sporadic, have been distinguished. In the

familial type of hemophilia the blood is viscous, flows slowly. There is a constant diapedesis of leukocytes, with a diminished number of polynuclear and a predominance of mononuclear forms.

Clotting is very slow, lasting from two and one-half to nine or even twelve hours.

In the sporadic form the blood is thin and watery. The blood-picture is normal. The coagulation time is delayed thirty to fifty minutes.

The disease is of gynecologic interest chiefly because of the danger that attends puberty. It is probable that many of the severe menorrhagias and metrorrhagias that occur at puberty have a hemophilic source. The condition is not always easy to distinguish from that of menorrhagic chlorosis.

An acquired hemophilia has been described as occurring later in life, but in many of these cases there has been a history of purpura and morbus maculosus, which many authors regard as related to hemophilia (Payer).

In the hemophilic there is no retardation of the menarche, but the menstrual flow when established is most profuse and very resistant to treatment, and may sometimes cause the death of the patient. Payer quotes the figures of Foeuckel and Bohn, who found 10 deaths in 121 reported cases. No specific anatomic abnormalities have been found in the pelvic organs.

Several cases of serious or fatal hemorrhages at childbirth have been reported.

The treatment consists in trying to alter the chemical composition of the blood so as to favor its clotting or to apply styptic solutions to the uterine cavity. Of the last named, calcium chlorate (3 to 8 per cent.) solution and adrenalin have been used. Success has been gained by the injection into the blood of 10 per cent. gelatin solution. These methods have in the latest times given way to transfusions of human blood or to the injection of animal serums, especially those prepared from the horse and rabbit. If all other methods fail, hysterectomy can be employed as a last resort.

**Leukocytosis.**—The study of the white corpuscles of the blood is of great importance to the gynecologist in the detection and treatment of acute infectious processes. What constitutes a hyperleukocytosis that may be regarded as indicative of infection is a matter of wide difference of opinion, estimates varying from 10,000 to 30,000. In our experience we are accustomed to consider a white count of 15,000 as almost conclusive evidence of infection, while one of 11,000 or 12,000 creates a disturbing suspicion. In detecting local hidden infections following gynecologic operations the leukocyte count is most useful, while in observing the course of an inflammatory process with special reference to surgical intervention the frequent examination of the blood and charting of the leukocytosis is an invaluable guide, and one comparable in importance to the curve of pulse and temperature.

With regard to the relationship between inflammations and hyperleukocytosis infections may be divided into three classes: (1) Those which are so mild as to cause practically no leukocyte reaction; (2) those which are so severe

as to overwhelm the organism so that a leukocyte reaction is prevented; and (3) a long list of infections between these two extremes, in which the reaction is present and proportionate to the severity of the disease.

In the first class are included tubercular processes that are not complicated with mixed infections of other organisms; slight inflammations such as are seen in mild catgut infections are also counted in this list. The second class comprises such conditions as the sudden overwhelming streptococcus peritonitis and septicemia that on rare occasions follow abdominal operations. In the third class are included most of the septic conditions seen in gynecologic surgery, such as appendicitis, pyosalpinx, wound infections, parametritis, phlebitis, postoperative pneumonia, etc.

In the first part of an acute infection there is a marked increase in the polynuclear cells, which represent the active agents of the body for combatting the invasion of organisms. The number of these cells is ordinarily proportionate to the severity of the disease, the number of mononuclears and eosinophils being comparatively small. In order to follow the course of the infection it is necessary to chart the leukocyte count every twelve or twenty-four hours. A sudden drop in the number of polynuclears indicates a loss of reactive power in the patient and entails an unfavorable prognosis. A drop in the absolute number of the neutrophils, with a high percentage relative to the mononuclears and eosinophils, also indicates an unfavorable condition, for it shows that the reactive powers of the body are not keeping pace with the need for its combatting agents, the polynuclears. A cessation of the leukocytosis during an acute inflammatory process, followed by a stationary or gradually diminishing count, usually indicates a walling-off and localization of the infection.

If the contest against the invading organisms is successful the need for the phagocytic polynuclears is passed, and they give way to the mononuclear lymphocytes, whose duty is that of reparation. An increase of lymphocytes, both relatively and absolutely, is, therefore, characteristic of convalescence.

In the same way the eosinophils, which in the height of the conflict are absent or insignificant, appear during the healing process, "their increase indicating victory over the infection."

**Posthemorrhagic Blood-picture.**—After an acute hemorrhage there begins an immediate absorption of the body fluid to make up the loss in volume of the blood which normally constitutes about one-thirteenth of the body weight. This process is greatly hastened by the introduction of physiologic fluids into the body by mouth or rectum, subcutaneously or by intravenous infusion. The increase in fluid volume is more rapid than the regeneration of the red blood-corpuscles so that there is next a diminution in the red cells, each one of which possesses its normal hemoglobin content. Then the increase in the number of red corpuscles advances more rapidly than the hemoglobin content, so that the next phase is a relative deficiency of hemoglobin in the presence of a normal red count such as is seen in chlorosis (Walthard).

The viscosity of the blood is accentuated after acute hemorrhage, and there is seen a hyperleukocytosis and an increase in the number of blood-plates.

The regeneration of the blood after severe loss is surprisingly rapid if the hemorrhage is not repeated, as is frequently seen after bloody operations or

after patients have had severe uterine hemorrhages, such as sometimes occur suddenly from polyps, cancer, etc.

Too great loss of blood is by far the most common cause of surgical shock. In the present day of improved operative technic only the most difficult of gynecologic operations should be attended with shock as a result of loss of blood. By the prevention of the loss of blood patients with low hemoglobin can be operated on with comparative safety.

After chronic loss of blood from the genitalia (menorrhagia and metrorrhagia), the appearance of the blood is that of any secondary anemia, namely, diminution of red corpuscles and decrease of the hemoglobin content, poikilocytosis, and absence of leukocytosis.

**Extravasation of Blood.**—Large extravasations of blood, such as are most typically seen in extra-uterine pregnancy, are followed at first by the characteristic posthemorrhagic blood-picture, described above—*i. e.*, diminution in the number of red corpuscles and hyperleukocytosis. If the hemorrhage is not repeated the red cells soon regenerate, but absorption of the products of degenerative changes in the blood cause a continuation of the leukocytosis which may reach a considerable height without the invasion of bacterial organisms. If the hematocele undergoes thick, fibrinous encapsulation as the long-standing non-infected cases often do, the leukocytosis disappears. If the hematocele becomes infected, hyperleukocytosis returns and follows the course seen in other purulent processes (Walthard).

The presence of leukocytosis after blood extravasation, or as the result of absorption from a degenerating hematocele, creates sometimes an element of confusion in making a differential diagnosis between ectopic pregnancy and inflammatory adnexal disease, being one of numerous other signs and symptoms which the two diseases have in common.

**Necrotic Tissue.**—The absorption of products of degeneration in necrotic tissue is attended with an increase in the leukocytes to 15,000 and over (Walthard). This is a matter of importance, chiefly in cases of torsion of ovarian cysts and necrotic myomas. If infection takes place, as it often does as a result of adhesions to the intestines, the leukocytosis follows the usual course of inflammatory processes.

**Postoperative Leukocytosis.**—Numerous observers have described a hyperleukocytosis following surgical operations, especially after those that involve the abdominal cavity. The highest point (about 16,000 and sometimes over) is said to be reached on the second morning, from which time it gradually recedes and disappears in about three and one-half days. The amount of the leukocytosis is dependent to some extent on the position, length, and severity of the operation. Many causes have been announced to account for the phenomenon, such as the loss of blood, anesthesia, opening the abdomen, injuries from instrumentation, etc. Some regard it as always an indication of sepsis (Zangemeister), while others consider that "it represents the measure of the

reaction of the organism against infection." Apparently, it bears some relationship to the postoperative increase in temperature which it parallels rather closely.

Jochmann considers it an indication of the process of healing. According to his theory, the leukocytes wander to the seat of the wound, where, upon their disintegration, a proteolytic ferment is set free. This ferment is in part absorbed, but a part is used for the digestion of the tissue fragments resulting from the trauma of the operation. By this digestive process there are set free in the circulation albumoses, which of themselves are capable of raising the body temperature. In this way is very ingeniously and plausibly explained the parallelism of fever and leukocytosis after abdominal operations. (Abstracted from Adolf Payer.)

## SERODIAGNOSIS

**Abderhalden's Test for Pregnancy and Cancer.**—A serodiagnostic test for the presence of pregnancy and cancer has been discovered by Emil Abderhalden, which, though at present in the experimental stage, bids fair with improvement and simplification of technic to be of very great clinical importance.

The test is based on the assumption that when a foreign protein is introduced into the blood certain protective ferments are manufactured in the blood that are capable of splitting up the foreign protein into peptone or amino-acids. This constitutes a form of digestion which is termed "parenteric digestion," and is a physiologic process of great value in the bodily economy. The protective ferments may be produced in the blood in various ways. Thus, in the ordinary process of intestinal digestion the intestinal tract may be so overloaded that food in complex form may pass into the circulation and call forth digestive ferments in the blood, which splits up the invading proteins into substances that are not harmful to the organism. The protective ferments may be artificially created in the blood by intravenous or intra-abdominal injections of foreign protein material. The protective ferments are also manufactured in the blood of an individual who harbors certain tissues in the body from which unchanged protein material may be absorbed in the circulation.

Specific examples of tissues of this kind are the placenta and cancer. This makes the subject of peculiar interest to the gynecologist.

The principle involved in this reaction of the blood to foreign protein material is of vast importance in modern scientific medicine. To quote McCord: "The formation of protective enzymes then is sensitization, and all the phenomena of anaphylaxis and immunity are closely allied. In this phenomenon is the basis for all prophylactic vaccination and the foundation for the creative activity of such substances as tuberculin. Although physiologic in its nature, the disintegrating of stable proteins is not without its deleterious action, as is evidenced by auto-intoxications. Such an enzyme cleavage of proteins underlies the various cutaneous reactions, such as leprodiagnosis, tuberculin reaction, and the cutaneous reaction of syphilis. These phenomena come as a result of introduction and cleavage of substances of a kind like unto that with which the organism is sensitized. Not only will this cleavage take place within the body, as in the instances cited, but the drawn blood contains the active enzymes, and when placed in contact with substances against which they are generated structural disrupting occurs extracorporeally with a breaking down into simple forms similar to that occurring intracorporeally."

Abderhalden began his work in the study of pregnancy. It has been known for some time, as demonstrated by Veit, Schmorl, and Weichard, that chorionic villi are discharged into the maternal circulation during the period of placental development. Abderhalden showed that this material, circulating in the form of a foreign protein, creates specific digestive ferments in the blood, and that when the mother's blood is drawn these ferments will still continue to act *in vitro* on placental tissue taken from some other human source. In this way, therefore, he discovered a means of diagnosing pregnancy.

The method of determining the presence of the specific protective ferment is to bring a small amount of serum from the individual to be tested in contact with a preparation of placental tissue, and to observe whether or not the serum has the power of digesting the placenta.

This can be done either with a polariscope or by the method of dialysis, by which the simple products (peptone or amino-acids) into which the placental protein has been split by the serum ferments may be detected by certain color reactions.

The technic of carrying out the test is somewhat complicated and must be learned from writers who are experimenting with it. The descriptions given by Ball are recommended by the author as being especially clear in detail. Among other writers on the subject are Williams and Pearce, McCord and Boldt. The German literature of the last two or three years is replete with the subject.

It may be said, in general, that the placental tissue to be used in the test is first prepared by boiling and coagulation, and then placed in a mixture of chloroform and toluol, in which it can be kept indefinitely.

The serum from the individual to be tested is obtained by venous puncture and must be absolutely free from hemoglobin.

The dialysis tubes usually recommended are the diffusion membranes of Schleicher and Schull, which should be first tested for their permeability to peptones. Small quantities of the prepared placenta and the serum from the individual to be tested are placed together in the diffusion tube, which is then placed in a small beaker of water. The apparatus is then put in the incubator for twelve to twenty-four hours at 37° C.

If the patient to be tested is pregnant the ferments contained in the serum split up the protein of the placental tissue into peptone or amino-acids, which permeate the dialysing membrane into the surrounding water. The presence of peptone in the water is detected by adding a watery solution of triketo-hydrinenhydrat (ninhydrin), which gives a deep-blue color reaction. If the reaction is negative, the solution remains colorless or turns a slight yellow.

According to Williams and Pearce, "results as satisfactory as those by dialysis are obtained by mixing tissue and serum in tubes, and, after incubating for twenty-four hours, testing the filtrate on coagulation by heat and acetic acid with ninhydrin."

Opinions differ as to the present value of the Abderhalden test for pregnancy,

some regarding it as too inaccurate to be of much clinical value, while others consider it reliable and practical (McCord). The test requires much skill and care, there being numerous chances for error. For that reason it has not yet come into general practical use.

Since Abderhalden has given out his pregnancy test it has been demonstrated that cancer produces in the blood a protective ferment very similar in action to that evoked by the condition of pregnancy. By this it is to be assumed that, as in pregnancy, certain protein material from the cancerous growth is discharged into the circulation, and causes a reactionary manufacture in the blood of the protective ferment. As Ball has pointed out, "one would expect that a ferment, if produced at all, would be elaborated more vigorously in a pathologic process than would be necessary in a purely physiologic one. It would also appear that a person in apparently good health possessing a cancerous growth might elaborate a stronger ferment than a person far advanced with disease."

These conclusions have been shown to be true, for Ball has observed an increase in the density of the color reactions in his cancer cases as compared with that in his pregnancy tests, while Brockman finds that healthy cancer patients give a denser reaction than do patients well advanced with the disease.

The principle and technic in making the test for cancer are the same as for pregnancy, excepting, of course, that the tissue to be tested is taken from fresh cancerous material instead of from placenta.

The value of serodiagnosis for cancer is at present in a somewhat problematic state, but it is probable that with improvement in technic, and with increased knowledge of the principles of the reaction, the test will in time prove to be of great general benefit.

## RELATIONSHIP OF GYNECOLOGY TO THE ORGANS OF CIRCULATION

Certain differences in the organs of circulation between the sexes are to be noted.

The heart and blood-vessels of woman are both relatively and absolutely smaller and weaker than in man. The heart is smaller and weighs less at a given age. Thus, according to the figures of Müller, the average of weight of the female heart between the ages of thirty and forty is 234.7 gm., as against 297.4 gm. for the male. It has been demonstrated (Kani) that the difference in the blood-vessels between the sexes is due to a greater thickness of the media in the vessel wall in man, a point which Jaschke thinks may be shown to have important clinical significance.

In woman there is a more frequent high bifurcation of the aorta, while the apex of the heart is relatively higher, due to the shorter thorax and to the smaller size of the heart. Physiologically, the pulse-rate in woman averages higher and the fluctuations are greater.

A special female characteristic is marked vasomotor excitability resulting

from the emotions, which may be so great as to produce uterine bleeding, a phenomenon of familiar occurrence. This vasomotor sensitiveness has an important bearing in a vast number of ways, both in the physiologic and pathologic sphere of woman.

The blood-pressure in woman is relatively lower than in man, and is subject to greater fluctuations, as a result of the greater lability of the pulse and of variations referable to vasomotor and psychic excitability.

## THE HEART

At puberty the heart becomes markedly increased in size. With the establishment of the menses are often seen in girls functional irregularities of the heart, which may in some cases be of a more or less serious nature. Most commonly they consist of palpitation and vasomotor manifestations, such as blushing, blanching, faintness, fluttering of the eyelids, etc. In severe cases the frequency of the pulse may be very marked and attended with pain in the region of the heart, shortness of breath, feeling of oppression and rapid breathing, symptoms which disappear after the onset of the blood, to reappear at the following periods with diminished severity. In these cases heart lesions or changes in the size or tone of the heart cannot be detected.

Circulatory disturbances at puberty are seen most frequently in individuals who have a neurotic inheritance and in those whose early environment has predisposed them to an unstable nervous equilibrium. In some, indications of enlarged thyroid and hyperthyroidism can be seen. Chlorosis, anemia, and the various hypoplasias are conditions especially apt to be attended with heart symptoms at puberty.

Sometimes the above-mentioned symptoms continue to recur at the menstrual periods, especially if there is dysmenorrhea. Jaschke describes a type of case in which the heart symptoms alternate with those of menstrual pain, and applies the term "vicarious dysmenorrhea" to the condition.

Other conditions that predispose to functional cardiac anomalies at the menses are hyperthyroidism and pelvic diseases, especially those attended with menorrhagia. In young women with amenorrhea, heart murmurs can often be demonstrated periodically, only to disappear after the return of the menses (Jaschke).

During cohabitation subjective heart symptoms may appear, and if organic lesions be present the symptoms may be alarming. Kirsch calls attention to the injury to the functions of the heart resulting from long-continued incomplete orgasm, such as is caused by impotence of the husband, precocious ejaculation, coitus interruptus, and the use of condoms and vaginal preventives to conception. The heart symptoms from this cause (tachycardia, heart weakness, dizziness, etc.) are only partial evidences of a general nervous weakness, which is manifested elsewhere by backache, pelvic pressure pains in the legs, and numerous other symptoms, all due to the same cause.

Increased functional irritability of the heart is observed at the climacteric. At this period of life appear also special characteristic vasomotor symptoms, the well-known "Ausfallserscheinungen." These consist chiefly of hot flushes or sensations of heat which appear momentarily. They are dealt with more fully elsewhere. (See Climacteric.)

Schickele believes that the vasomotor disturbances of the change of life are due to a rise in blood-pressure consequent upon the absence of the ovarian secretion which normally acts as a blood depressant. This theory has not been entirely substantiated.

It should be said that functional cardiac manifestations seen in relation to pelvic changes, especially those of the critical periods (menarche, menstruation, pregnancy, and the menopause), are by no means constant, but are principally seen in individuals of a neurasthenic or hysteric temperament.

Long-continued bleeding from pelvic disease may cause anatomic changes in the heart muscle, a condition sometimes referred to as "the anemic heart" (Walthard). There is seen a fat deposit in the protoplasm of the cells of the heart muscle, an appearance not to be distinguished from true fatty degeneration. The condition has been shown experimentally to be the result of incomplete oxidation. At the same time there takes place a dilatation of the heart, which, however, is not permanent, disappearing as it does after cessation of the uterine bleeding and restoration of the blood to its normal constituency. The therapy of the anemic heart resulting from pelvic disease is, therefore, identical with that of the pelvic disease.

Pelvic diseases that are attended with long-continued disturbances of nutrition and respiration, like large ovarian cysts, myomata, and tumors associated with ascites, lead to brown atrophy of the cells of the heart muscles, a condition seen at autopsy in cases where there has been cachexia and marasmus.

The relationship between the genitalia and organic lesions of the heart is not a particularly definite one, there being very little causal connection between diseases of the two systems. In uncompensated valvular heart disease with edema and ascites the labia majora may become swollen and edematous. It is observed also that long-standing uncompensation may be attended with edema and hypertrophy of the uterine mucosa, leading to menorrhagia and metrorrhagia, though in the light of recent research this explanation of the bleeding must be accepted with reserve.

A rare result of heart disease, mentioned by Jaschke, is an excessive bleeding from a corpus luteum from which it is claimed there may ensue an adhesive peritonitis. There is no doubt that under normal conditions considerable blood is not infrequently shed from the corpus luteum. Under the influence of the chronic passive congestion of heart disease it is reasonable to believe that such a hemorrhage may be much greater than that which takes place under physiologic conditions.

The secondary anemia from bleeding fibroids and other tumors, which is

manifested by a temporary compensatory enlargement of the heart, leads also to changes in the walls of the veins which predispose to thrombus formation. Infection of the thrombus may take place, with the sending off of septic emboli into the circulation.

**Myoma Heart.**—Of particular interest to the gynecologist is the so-called "myoma heart." The frequency with which functional and sometimes organic changes in the heart are associated with uterine fibroids has in times past led to the belief that there exists a definite immediate causal relationship between the two conditions. Just how the heart lesions are produced was not clearly explained. Some have believed that fibroid tumors manufacture a toxin which in circulating through the blood exerts a deleterious influence on the heart. Neu advanced the interesting theory that the changes in the heart are secondary to hypertrophy of the thyroid gland, which of itself is in some way induced by the myomatous growth. Thus the cardiac symptoms by this theory are in reality manifestations of hyperthyroidism. The general tendency at present is to ignore any causal relationship between the heart disturbance and fibroid growth, excepting in cases of long-continued bleeding in which compensatory changes are seen in the heart, such as are mentioned above in describing the anemic heart—changes that would appear in a secondary anemia from bleeding in any other part of the body.

Certain vasomotor symptoms are sometimes observed in women who have fibroids, such as tremors, hot flushes, dizziness, tachycardia, etc., which have seemed to substantiate the claim of the toxic influence of fibroid tumors. These symptoms, however, are frequent in women without fibroids, and occasionally appear for the first time after hysterectomy for fibroids, so that they are not valuable evidence in support of the claim. Notwithstanding the present trend to disassociate myomata from heart lesions and to discard the toxic theory of uncomplicated fibroids, it is well to reserve judgment until the facts are better established. The profound effect which fibroids without local symptoms often have on the general organism of woman, and especially on her nervous system, certainly suggest that the older theories may not be without basis.[1]

## THE BLOOD-VESSELS

Arteriosclerosis as the result of infectious diseases, especially of syphilis, may occur in young women and be the exciting cause of menorrhagia and metrorrhagia. Non-infectious arteriosclerosis has in times past been supposed to play a very important rôle in the causation of uterine hemorrhages. In its general aspects arteriosclerosis is less common in women than it is in men, but it has been shown that the vessels of the female genital organs, and especially

[1] Huggins, from observation of his own cases and a study of the literature, believes that uterine fibroids produce a specific toxin as a result of cell growth, which exerts an injurious effect on the organism entirely apart from the results of hemorrhage or pressure. Most important is the degenerative influence on the heart which he places at from 40 to 50 per cent. of cases. In addition to the nervous disturbances mentioned above, he calls attention to the frequency of pyelitis in association with non-obstructing fibroids and assigns the cause to non-resistance resulting from toxic products from the growing fibroids.

of the uterus, possess a special predisposition to become sclerotic. This has been demonstrated both in those who have had frequently repeated pregnancies, a long-recognized cause for arteriosclerosis, but also in the nulliparous. Pankow states that he can distinguish special forms of local sclerosis, due to child-bearing and to menstruation in virgins, and speaks of pregnancy-sclerosis and menstruation-sclerosis. A special preclimacteric arteriosclerosis has been shown to be a not uncommon cause of premature thickening of the vessels, especially if there be added the effect of frequent child-bearing.

In the unmanageable uterine bleeding, so often seen in women near the menopause without demonstrable anatomic abnormality, arteriosclerosis has been widely accepted as a most important cause, but more recent investigations tend to prove that its influence in this condition has been very greatly exaggerated. The present trend is in favor of irregularities in the function of the ovaries as the chief etiologic factor.

**Thrombophlebitis.**—Phlebitis is a matter of interest to the gynecologist, in that it constitutes a somewhat frequent and troublesome complication in the convalescence of pelvic operations.

The form of phlebitis most commonly seen in the practice of gynecologic surgery is of the so-called septic non-pyogenic type, and is the result of attenuated or non-virulent organisms circulating in the blood and lodging in the inner coat of a vein, usually of the lower extremity. The introduction of the organism into the circulation can probably take place at the time of the operation, or it may be the result of a mild unrecognizable sepsis at the seat of operation. The offending germ after lodging in the intima of the vein causes a lesion of the membrane which results in a thrombus and a local inflammatory process, though just how this process comes about is not definitely known.

McLean regards as an important cause of thrombosis the necrosis of tissue remnants at the seat of operation, which harbor a low grade of infection and send off toxins into the circulation favorable for the development of a thrombus. This theory seems a very reasonable one, for thrombosis is especially apt to follow operations where there is much tying of pedicles and leaving of ragged shreds of tissue.

Extension of the thrombus, lymphangitis, and edema cause a swelling of the leg which varies greatly in amount in different cases. There is always pain, and if the swelling is considerable the surface becomes white and shining, a condition to which the name "phlegmasia alba dolens" was given in ancient times.

In by far the greater number of cases the disease starts in the veins of the lower leg, the first evidence of trouble being a sharp cramp-like pain in the calf. In most cases it extends upward along the internal saphenous vein, causing pain and tenderness along the inner side of the thigh. In more serious but less frequent cases the inflammatory process of the vein may extend past the femoral ring into the veins of the pelvis, or it may originate in the femoral or iliac veins. Postoperative phlebitis usually appears between the eighth and twenty-first

day of convalescence, though it sometimes does not make itself evident until several weeks later. The course of the disease varies within wide limits, the mildest cases lasting only a few days, with no after-effects, and the more severe cases lasting weeks, and often resulting in permanent enlargement and partial disability of the leg.

Thayer found, in an examination of a number of cases of postoperative thrombosis several years after the operation, that when the iliac and femoral veins were involved there was usually a permanent enlargement of the leg. Schenck estimated that about 65 per cent. of patients with postoperative phlebitis never completely recover, and that if recovery is to take place it will come within the first year.

Phlebitis is practically always attended with moderate rise of temperature, which often appears several days before the onset of subjective symptoms.

*Postoperative phlebitis* of the non-pyogenic type should always be regarded as a serious affection, the chief danger being the possibility of a separation of an embolic clot from the thrombus. This danger is present in cases of the mildest forms, and is to be considered for several weeks after the patient's apparent recovery. Numerous cases of pulmonary embolism have been reported in consequence of the application of massage to relieve the pain of phlebitis. Nurses should always be given strict instructions concerning the nature and position of pain in phlebitis. This is particularly important because the initial symptoms are usually regarded by the patient as those of muscular cramp.

Another danger to which a patient with phlebitis is subject is the possibility of the disease changing from non-pyogenic to the pyogenic type.

*Pyogenic phlebitis* usually starts as such, and represents the infection of a more virulent organism than does the preceding form. Whereas non-pyogenic phlebitis often follows what may be called "clean" operations, the pyogenic type, as a rule, is preceded either by an operation for some purulent condition or by postoperative active sepsis at the seat of the operation, such as stitch-abscess of the wound, septic parametritis, etc. The course of pyogenic phlebitis is a severe and alarming local sepsis about the affected part of the vein with marked constitutional reaction. Pyogenic phlebitis following gynecologic operations usually appears in the leg and tends to remain localized. It may, however, become diffuse, enter the circulation, and cause a fatal septicemia, or it may send septic emboli to distant parts of the body, causing pyemic abscesses.

*Treatment.*—The preventive treatment of postoperative phlebitis is unremitting attention to surgical asepsis, but, even with the greatest precautions and with apparently perfect healing of wounds, phlebitis occasionally appears.

If we accept the theory of McLean, that thrombophlebitis is the result of necrotic tissue remnants, it is evident that clean, skilful surgical technic with considerate handling of tissues is of the greatest importance in preventing the complication.

Treatment of the non-pyogenic cases consists in complete rest in bed with elevation and immobility of the leg. Comfort is given by applying an immense cotton swathing to the leg, surrounded by hot-water bags. Local medical applications to the leg are of no great curative value, but relief to the pain is sometimes afforded by painting the leg with ichthyol or by applying compresses soaked in a weak lead-and-opium lotion. Matas recommends kaolin poultices.

The treatment of purulent phlebitis is usually surgical, and consists either in incision and drainage or, in some cases, if the disease is sufficiently localized, in excision of the infected area with ligation of the vein above.

**Embolism.**—The subject of embolism is also of particular interest to the gynecologist in view of the fact that fatal embolism is peculiarly common after pelvic operations, especially those which implicate the hemorrhoidal and pampiniform plexus of veins and those which involve the appendix. In operations for strangulated hernia there is said to be especial danger of embolism, due, according to Gussenbauer, to the fact that the thrombi are formed in the veins of the strangulated loop and set free in the circulation when the obstruction is released.

In nearly all statistics fatal embolism after hysterectomy for fibroids plays a somewhat conspicuous part. In our experience the accident has happened most frequently after minor pelvic operations during which the appendix was removed as a routine procedure.

Postoperative emboli occur most frequently in the lungs, other less common places being the kidney, spleen, brain, and pleura.

The cause of surgical embolism cannot always be traced. Thrombophlebitis, especially of the pelvic veins, with release of a small blood-clot into the circulation, is probably often the underlying cause, especially in those cases in which the embolism takes place at a considerable time after the operation.

Undoubtedly, the manner of ligaturing the pelvic veins is of very great importance, a clean, skilful, and bloodless technic probably being the best prophylactic against the accident.

Pulmonary embolism may occur during the operation, a short time after it, or at any time during the convalescence, often not until the patient is up and about.

If the embolus is a large one, death may be instantaneous. Usually the patient does not die until several minutes after the first symptoms, which consist of sudden pain in the chest, difficulty of breathing, rapid pulse, deep livid color of the face, faintness and premonition of death, with rapid loss of consciousness. Pulmonary emboli are not always fatal. A small aseptic embolus may cause only a sharp pain, with a temporary distress in breathing and fleeting cyanosis, all symptoms disappearing in a few moments not to return, with the possible exception of slight lingering pain in the chest.

Small non-fatal emboli may result in a hemorrhagic infarct of the lungs,

causing a moderate elevation of temperature for several days, with signs in the chest of localized consolidation and serofibrinous pleurisy. The infarct may be sufficient to cause hemoptysis.

If the embolus is discharged from a septic thrombus, the lodgment in the lung may result in a serious pulmonary abscess.

**Varicose Veins (Varices, Phlebectasis).**—Varicose veins relate to a condition of permanent dilatation due to changes in the vessel walls. The term "varicose veins" is most commonly applied to the varices which occur in the lower limbs. These are far more common in women than in men, a result of the special obstructing influence exerted by the pregnant uterus on the veins. The venous enlargement usually takes place in the superficial veins, sometimes in the deeper vessels. In a third of the cases due to pregnancy the affection is bilateral, according to Jaschke, and when unilateral or more marked on one side than the other the veins of the right leg suffer more, probably on account of the tendency of the gravid uterus to rest in the right side of the pelvis. As a rule, the varices of pregnancy disappear after delivery of the child, but the stretching of the veins predisposes them to greater danger of thrombosis, phlebitis, and, later, permanent varicosities (Jaschke).

Varicose veins of the leg of long duration are on account of their exposed position especially subject to trauma, with consequent rupture or septic thrombophlebitis. On account of the incompetent circulation, lesions of the veins do not heal readily and indolent ulcers very frequently result. If the ulcers are neglected the surrounding tissues undergo a change, due chiefly to involvement of the lymphatics, and become thickened, brawny, and insensible, a condition resembling elephantiasis.

Varicose veins of the legs, with their various complications, are so common in women that the affection may well be included in the list of gynecologic diseases.

Varicosities of the veins of the vagina and vulva, though less common than those of the lower extremities, are by no means infrequent as a complication of pregnancy, and are a source of serious danger from rupture as a result of trauma, especially that from coitus or childbirth. Fatal hemorrhages from this cause have been reported. The condition is discussed in greater detail on page 305.

Varicosities in the vaginal plexus of veins lead at delivery to separation of the vaginal mucous membrane from the paravaginal tissue, and hence predispose to later prolapse (Jaschke).

A most important phase of varix formation is that which takes place in the pampiniform plexus of veins in the broad ligament in conditions of chronic pelvic congestion, especially when due to malpositions of the uterus. According to Opitz, and in this our own experience coincides, many of the pelvic pains that attend uterine displacements are due to varicose veins in the broad ligaments. These varicosities are often so tender as to cause a mistaken diagnosis of inflammatory adnexal disease. Restoration of the uterus to its normal posi-

tion will often, though not always, cause the venous engorgement to disappear with complete relief of symptoms.

The pelvic veins may become varicose from pregnancy or from large tumors, and Jaschke has reported fatal intra-abdominal hemorrhages as a result of this condition.

Other phlebectases occurring as the result of pregnancy are seen in rare instances in relation to the uterine cervix and body, to the bladder, rectum, and stomach (Kaufmann, Halban, Bachrach, Ewald, Preiss).

## RELATIONSHIP OF GYNECOLOGY TO THE NERVOUS SYSTEM[1]

**Influence of Menstruation on the Nervous System.**—In considering the relationship between the genital and nervous systems one naturally regards first the important influence which the function of menstruation has on the general organism of a woman.

John Goodman, in 1878, in an essay entitled "The Cyclical Theory of Menstruation," was one of the first to call attention to the fact that the function of menstruation is not a purely local process, but the expression of a profound change in the general circulatory system. This periodic change in the circulation Goodman regarded as under the direction of the nervous system and as following a regular law of rhythmic rest and activity, such as is represented by the heart action.

Mary Putnam Jacobi, in the Boylston prize essay of Harvard University for 1876, presented, under the title of "The Question of Rest for Women during Menstruation," a most valuable contribution to the physiology of the pelvic organs, by expounding for the first time the *wave* theory of menstruation.

According to this theory, menstrual blood represents the overflow of superfluous nourishment material which has been stored up as a provision for impregnation, but which when impregnation does not take place is discharged in the form of a catamenial flow.

Jacobi saw in this a rhythmic wave in the metabolic processes of woman which reaches its maximum immediately before and its minimum immediately after menstruation. In order to prove her theory, Jacobi made monthly observations on several women and established that just before the menstrual period there is an increase in the body temperature, in the blood-pressure, in muscle strength, and in the pulse-beat, all of which gradually diminish during the menstrual period and are at their lowest ebb at its close.

These observations were confirmed by other investigators. In 1890 von Ott and his pupil Schicharell studied in 57 normal women through 68 menstrual periods the temperature, pulse, blood-pressure, muscle strength, lung capacity, inspiration and expiration strength, and the ocular reflexes, and from these studies concluded that the energy of the functions of the female organism is at its

[1] Some of the material in this section is taken from an article by the author, published in the Boston Medical and Surgical Journal, 1913.

height immediately before menstruation and that it diminishes from the time of the beginning of the flow of blood. Von Ott constructed a curve which represents graphically the monthly wave of the life processes of normal woman (Fig. 24).

The discussion as to the physiologic cause of this menstrual wave of depression, whether it is the result of an ovarian internal secretion, whether it is from a rhythmic change in the central nervous system, or what not, is not at present conclusively established. The curve of Ott shows plainly that there is in the organism of the healthiest woman a monthly period of depression in her vital processes which finds definite expression in all her activities. This fact is of the very greatest importance in our understanding of a woman, either as an individual or as a patient. As Havelock Ellis has pointed out, the chart of von Ott would probably be paralleled, if it were possible to make accurate observations, in all the senses, emotions, and intellectual activities of women.

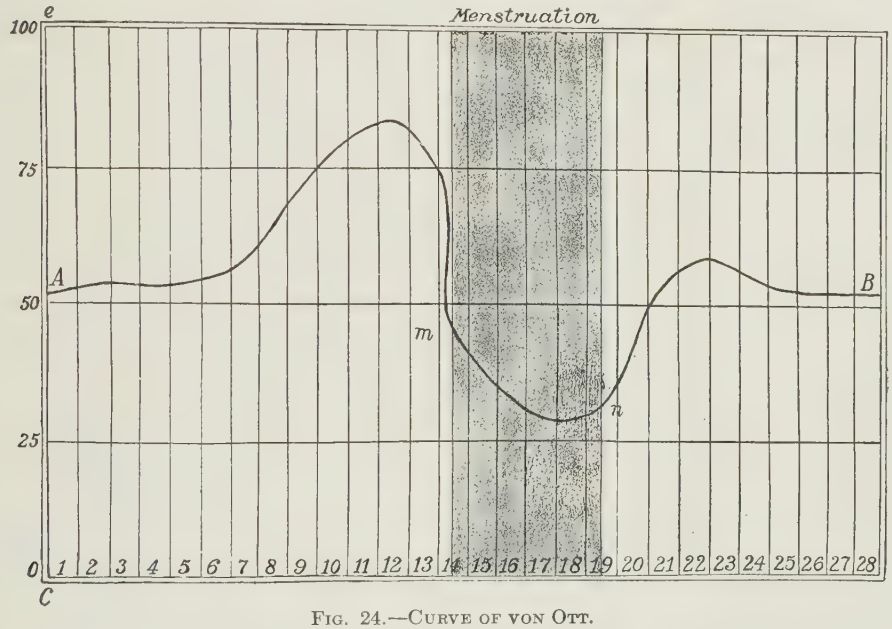


Fig. 24.—Curve of von Ott.

In the preceding sections on the relationship of gynecology to the general organism we have seen that during menstruation the most varied disturbances take place in nearly every part of the body—*i. e.*, in the organs of sense, in the digestive tract, in the skin, in the circulatory apparatus, etc. In the psychic and nervous organization of perfectly healthy women the menstrual curve is very plainly manifested. There is at that time a greater sensitiveness and impressionability. The individual is far more irritable and subject to outbursts of ill-temper and to unreasonable caprices. There is markedly less self-control and an invariable tendency to depression. The nervous reflexes are impaired and women are less skilful and dextrous during the menstrual period.

What we have said so far relates to women in perfect health. Under patho-

logic conditions the same upward and downward curve occurs, but the changes may be much more marked.

In considering the pathologic aspects of the relationship between menstruation and nervous disorders we must view the subject in two aspects.

First, neuroses that are dependent entirely on an abnormal menstrual function. In this case cure of the menstrual difficulty results in cure of the neuroses.

Second, abnormalities of the nervous system which are made worse by the menstrual function. In this case, cure of a menstrual irregularity or arresting of menstruation is a source of relief, though not necessarily a cure, to the nervous abnormality.

(1) *Neuroses as a Result of Menstrual Irregularities.*—Of the menstrual irregularities that may produce neuroses, dysmenorrhea is by far the most important. By the term "dysmenorrhea" is meant the so-called essential dysmenorrhea, which consists of cramp-like pains of the uterus, felt usually in the front of the lower abdomen, occasionally in the sacral region. The pains of pelvic inflammation, chronic appendicitis, or other abdominal disease that are exaggerated during menstruation are not included under the term "essential dysmenorrhea" (*q. v.*). Essential dysmenorrhea is undoubtedly a purely physical sign, and, in the majority of cases, has some definite anatomic basis. The condition commonly associated with true dysmenorrhea is a local hypoplasia of the genital organs, in which there usually exists a malposition of the uterus, in the form of a retrocessed anteflexion or a retroversion-flexion of developmental origin, or there may be malposition without hypoplasia. In a great number of these cases the individual is otherwise perfectly normal and there is often no predisposition to lack of nervous equilibrium. The painful periods at first often have little effect on the patient; but gradually, as she grows from girlhood into womanhood, permanent nervous manifestations of irritability, exhaustion, and depression make their appearance. The curve of menstrual depression becomes deeper and deeper, and the return to the normal becomes later and later, during the intermenstrual period. Such patients no sooner recover from the effects of one period than they begin to dread the effects of the next one. The condition is, therefore, one of continual hammering at the patient's nervous system and eventuates gradually in seriously affecting it. It is no wonder, therefore, that patients with dysmenorrhea nearly always in time become neurotic. The mistake, however, must not be made in supposing that the dysmenorrhea is in these cases the result of the neurotic condition. It is held by some that psychic and nervous conditions frequently induce chronic dysmenorrhea. This may possibly be true in some instances, but it is certainly uncommon. Such cases are, therefore, primarily for the gynecologist, who must do what he can to relieve the underlying pelvic condition. Unfortunately, essential dysmenorrhea is difficult to treat successfully, but a certain percentage (50 to 75) yield to surgical treatment with immediate improvement of the nervous condition. It sometimes happens that the dysmenorrhea cannot be cured by any

known means and the patient develops into a hopeless invalid, a burden to herself and her friends. In these extreme cases castration with hysterectomy is justifiable and indicated. In properly selected cases the cure of the mental and nervous condition may be complete.

Other irregularities of menstruation besides dysmenorrhea may be the underlying cause of psychoneurotic conditions. Menorrhagia, for example, may so deplete the patient's general health and resisting power as to produce neurasthenic states, especially if there be coupled with it the fear of cancer. Continued amenorrhea may be the cause of mental depression; but where it is associated with grave mental disorders, such, for example, as dementia præcox, it must be regarded only as a symptom of the disease.

It should be noted that disturbed psychic states may exert a certain amount of temporary influence over the function of menstruation. It is extremely common for gynecologic patients who are being prepared for operation to menstruate much out of their regular time. Sudden nervous or physical shocks often bring on the menstrual flow. It is doubtful if ordinary nervous shocks cause permanent irregularity, though this claim is frequently heard. Fear or nervous shock may also cause temporary amenorrhea, as is often seen in women who fear impregnation, the menstrual period sometimes being delayed as much as ten days or two weeks under the influence of such apprehension.

(2) *Influence of Menstruation on Pathologic Mental and Nervous Conditions.*—In this class of cases the primary seat of trouble is in the nervous system itself, and it includes everything from hereditary functional disorders to serious organic mental disease. There is no doubt that all of these conditions may be aggravated during the menstrual period. If, in addition, the menses are also abnormal, the reaction on the nervous system is greatly increased.

The nervous disturbance may be expressed only by severe periodic headaches. Hysteria, hystero-epilepsy, epilepsy, erotomania, dipsomania, kleptomania, and melancholia frequently appear chiefly or solely at the menstrual period. Women with criminal or suicidal tendencies often show their inclinations at that time. To quote Havelock Ellis:

"Lombroso found that out of 80 women arrested for opposition to the police, or for assault, only 9 were not at the menstrual period. Legrand du Saulle found that out of 56 women detected in theft at shops in Paris, 35 were menstruating. There is no doubt, whatever, that suicide in women is specially liable to take place at this period; Krugelstein stated that in all cases (107) of suicide in women he had met with, the act was committed during this period, and, although this cannot be accepted as a general rule (especially when we bear in mind the frequency of suicide in old age), Esquirol, Brierre, de Boismont, Coste, Moreau de Tours, R. Barnes, and many others have noted the frequency of the suicidal tendency at this period. In England Wynn Westcott has stated that, in his experience as a coroner, of 200 women who committed suicide, the majority were either at the change of life or menstruating; and in Germany Heller ascertained by postmortem examination of 70 women who had committed suicide that 25 (or in the proportion of 35 per cent.) were menstruating, a considerable proportion of the remainder being pregnant or in the puerperal condition.

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"Among the insane, finally, the fact is universally recognized that during the monthly period the insane impulse becomes more marked, if, indeed, it may not appear only at that period. 'The melancholics are more depressed,' as Clouston puts it, 'the maniacal more restless, the delusional more under the influence of their delusions in their conduct; those subject to hallucinations have them more intensely, the impulsive cases are more uncontrollable, the cases of stupor more stupid, and the demented tend to be excited.' These facts of morbid psychology are very significant; they emphasize the fact that even in the healthiest woman a worm, however harmless and unperceived, gnaws periodically at the roots of life."

The preceding cases are primarily for the neurologist and the psychiatrist, yet there are certain of them whom the gynecologist may relieve. Cases of dysmenorrhea or menorrhagia should be submitted to the gynecologist, for if these symptoms can be cured the patient is relieved of an important nervous irritant. A limited number of cases of this class where the manifestations appear solely at the catamenial period are subjects for castration.

**Genital Psychoneuroses.**—The term "genital psychoneurosis" relates to a condition of mind which continually reverts to real or imaginary ills residing in the pelvic organs. In the strictest sense the designation "genital psychoneurosis" should be applied only to those cases in which the genital organs are actually sound and where the subjective symptoms are purely the result of imagination. In our experience, however, the pure genital neurosis is a comparatively rare condition, at least in gynecologic practice, the principal type being that of the individual who, having some physical basis for pain or discomfort in the pelvic region, exaggerates or overvalues both the pain and its significance. We may thus distinguish two types, one of which we will designate "the genital neurosis of imagination" and the other the "genital neurosis of overvaluation." In the former the pelvic organs are entirely normal, while in the latter there exists some pathologic or functional abnormality. This distinction is one of much clinical importance for on it depends the proper treatment of the case.

Genital neurotics of the purely imaginative type belong to that class of individuals who become consciously sensible of functions which normally belong to the realm of the subconscious, such as movements of the intestines, heart, and stomach, the attention having been directed to them accidentally or by the pain of some temporary aberration of function. The neurosis consists in the fixation or constant recurrence of the attention to the new sensations, even though the anatomic seat of the sensation is entirely normal.

It is a general belief that neurotics of this kind are extremely common, a belief that has come down to us from the earliest times, it being supposed that there is some very specific relationship between the female pelvic organs and the nervous system Improvement in the study and diagnosis of both neurologic and gynecologic patients tends to show that the number of pure psychoneurotics is much less than was formerly supposed, and many cases, at one time condemned as hopeless neurasthenics, are now found to be really sufferers from physical conditions that often can be alleviated. This applies not only to

gynecologic diseases, but to the affections of all departments of medicine and surgery.

The manner in which sensations that under normal conditions are subconscious, or that to the nervously sound are little heeded, come into the realm of consciousness and acquire exaggerated significance is graphically told by Austen F. Riggs, from whose "Talks to Patients" the following is taken.

Dr. Riggs pictures the field of consciousness as a great sea of immeasurable breadth and limitless depth. The surface of this sheet of water is covered with waves. Each impression made upon our consciousness from the time of birth to the present moment is represented by a wave, and the waves are arranged in groups and systems according to the laws of association.

"Now assume that the whole sheet is in total darkness, save that at or near the middle portion there is a light suspended from above which illuminates a very small area. It is a mere pencil of light, capable of illuminating but one wave at a time, but it has the faculty of very rapid motion, and is thus capable of illuminating a good many waves in such quick succession that it produces the effect of having illuminated them almost simultaneously. This light represents the attention. To carry out the figure, we must imagine ourselves suspended above it and as being able to control its direction by our will. Just as the searchlight of a battleship has a definite range beyond which the light does not reach, so the light of our attention can be projected over only a limited area of the sea of consciousness. All that lies outside this area, at any given moment, is, for that moment, subconscious, so that we speak of that portion of consciousness outside the range of the attention as the *subconsciousness* and that portion which lies within the illuminated area as the *consciousness*, or more accurately, the former is called the *unaware* consciousness and the latter the *aware* consciousness" ("Talks to Patients," Elementary Mental Mechanics).

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"Most of the time the vast majority of these waves stay quietly in the subconscious region, while only a small minority pass in and out of the aware region; but under certain circumstances a great many may obtrude themselves into the illuminated area, and when this happens, trouble promptly ensues.

"Each family of waves may be said to be made up of two subgroups; one of which, comprising the waves representing the sensations of position, of vibration, and the deep muscle and tendon sensations, is a stable, stay-at-home cluster which normally always remains in the subconsciousness. The other subgroup, which includes the sensations of touch, pain, and temperature, is more mobile, more loosely held together, and thus many of its members are easily drawn from the family circle into the aware region. Any of these mobile sensations become very easily accentuated by the ordinary physical stimuli of the environment and are thus constantly flashing in and out of the attentive region. Even without physical accentuation, one or more of them may be drawn to the attention if one simply thinks of this or that part of one's body, and, consequently, at once becomes superconscious of it.

"Bearing this mechanism in mind, it is easy to see that sensations of this class, after being repeatedly picked out and dwelt upon by an otherwise idle attention, will form a most unwelcome habit of finding their way with greater and greater ease into the aware consciousness and that consequently they will become exaggerated through repetition and overattention. This process, in fact, plays an important part in the genesis of hypochondriasis, where the sufferer becomes abnormally aware of many, one might almost say of all of his sensations; and it also plays no small rôle in numerous other sorts of 'nervousness.'

"There is another accident which may occur in the mental field which produces a similar result. Not only may the mobile sensations of the 'touch' class, of which we normally may or may not be aware, become accentuated and exaggerated, but even those sensations of which

we are normally never aware, namely those belonging to the stable, subconscious group, may, under certain circumstances, reach the light of our attention. This they do by virtue of a process of disassociation—that is, by a breaking up of the normal arrangement of sensations in subgroups and families. Thus when a family of sensory waves becomes accentuated (although usually only the more mobile subgroup of the touch and pain class is affected), provided that the mental constitution be liable to disassociation, the lightly balanced associative values of a whole family may be upset. The result is that one or more sensations of the stay-at-home group, which should have remained quietly at home in the subconsciousness, now disassociate themselves from this their normal cluster and promptly join the other subgroup of the family. They then assume the habits of their new companions and wander with them into the illuminated area. Thus not only does the 'touch' sensation become prominent, but it drags with it into the aware field one or more of its normally subconscious brothers. Here, of course, the latter literally 'make a sensation.' They wear the uniform, let us say, of the knee family and are, therefore, recognized as hailing from the knee country; but this is the only familiar characteristic they possess, and they are above everything fascinating to the attention because of the utter strangeness of all their other qualities. They are out of place—as startingly out of place as fish out of water. The sensations are perfectly normal in themselves, but they are distinctly and markedly abnormal in their relative position in consciousness. Like deep-sea creatures suddenly hauled gasping to the surface, they are out of their natural element, the quiet subconscious regions, and are showing themselves in the utterly strange environment of the intensely active and brightly illuminated aware region. Of course they seem unnatural, undesirable, and, furthermore, we treat them with fearful attention and respect, because they seem to signify that there is something very strange going on in the bodily region from which they emanate. The sufferer little realizes that their abnormality consists chiefly in malposition and not in intrinsic quality or significance.

"Once having gained the *entrè*, the dislocated sensations in question very soon acquire the habit of calling with always greater frequency and familiarity. Naturally the attention dwells with greater and greater intensity upon its strange guests, and the latter consequently swell to an enormous importance. Before long the secondary physical results make their appearance. The function over which the sensations in question formerly presided without let or hindrance now suffers overstimulation or overinhibition as the case may be. The sensation, because of its abnormal activity and also because of its malposition in consciousness, has attracted more than its share of the attention, and the latter consequently interferes with the nervous control of the function" ("Talks to Patients," II, Nervousness).

Cases of pure psychoneurosis with normal pelvic organs belong to the neurologist and psychiatrist. The duty of the gynecologist is to isolate these cases from those whose symptoms result from actual pelvic disease. Obviously, patients whose symptoms are imaginary are always of a neurotic constitution, but patients whose nervous symptoms are due to the irritation of pelvic disease may or may not have had a neurotic predisposition. Those whose nervous equilibrium is naturally unstable succumb more readily to pelvic irritants, but even those of the soundest constitution may become the victims of serious neuroses if the irritation be sufficiently protracted or combined with other elements of physical or mental strain.

In treating a neurotic patient who complains of pelvic pain or discomfort it is the safest plan to assume that the ills complained of are actual and not imaginary, though allowance may be made for a certain degree of exaggeration or overvaluation. By not observing this rule the gravest mistakes are often made.

The conditions which produce genital neuroses are more apt to be the minor

pelvic affections which, without causing severe symptoms, maintain a nagging discomfort and keep the searchlight of the attention constantly turned upon them. The most common and most important source of such neuroses is that which comes from the adhesions of chronic pelvic inflammation. The discomfort may be caused by peritoneal irritation or by the immobilization of organs which normally enjoy free motion in the pelvis. Of these, the adnexa suffer most, and more commonly those of the left side, the pain usually being referred to the ovary. The fact that even extensive adhesions may exist without detection by the most expert digital examination leads frequently to the diagnosis of psychoneurosis without physical basis, such terms as "ovarian neuralgia" being used to explain the sensations of pain.

Another most prolific cause of neuroses is prolapse of the pelvic organs. This causes a sense of pressure and weight. The patient becomes actively aware of her uterus, and finds it difficult to turn her attention from it. The exhaustion that attends work and physical effort deplete the strength and stimulate the nervous irritability. Patients of the strongest nervous constitution are subject to this form of genital neurosis. Reconstructive surgical operations in this type of case are among the most satisfactory in gynecologic practice.

Tumors which are attended with symptoms of adhesions or pressure, or that cause irregular menstruation or mental anxiety, produce neuroses. Unobserved, non-painful tumors, on the other hand, may reach large dimensions without producing the least effect on the nervous system.

The effects of irregular menses have already been dwelt upon. Affections of the external genitals are often the cause of severe nervous troubles. Leukorrhea, functional incontinence of urine, pruritus are of great clinical importance in this respect, as is pointed out in the sections devoted to those subjects. Senile atrophy and shrinking of the perineum deserve special mention. Vaginismus is the result either of a pure neurosis or may be due to some painful lesion.

Many neuroses have a sexual origin and may result from sexual disharmony between husband and wife, disappointment at not bearing children, fear of impregnation, masturbation, shame, etc.

The subject may be summed up by the statement that chronic pelvic conditions that cause constant or frequently repeated painful or disquieting sensations produce functional neuroses and psychoneuroses, the extent of which depend partly on the duration and severity of the symptoms and partly on the inborn lack of resistance to nervous stimuli on the part of the patient. The genital neuroses, however, do not differ in character from those originating in other parts of the body, and do not represent a mysterious specific nerve connection between genitalia and brain, as was formerly supposed. The frequency of genital neuroses, as compared with others, is due to the complicated nature of the genital organs and the ease with which they are thrown out of a normal equilibrium.

The *treatment* of genital neuroses is directed toward the local cause of irri-

tation, and requires exact diagnosis and tactful judgment, for if cases of this kind are improperly treated the effects are serious. The success in treatment depends on relieving the irritating local symptoms. If pelvic disease can be definitely excluded the patient should be treated neurologically, for in this case all forms of gynecologic treatment are usually harmful.

**Effects of Castration.**—The subject of postoperative neuroses following hysterectomy and castration is of special interest to the gynecologist because of the frequency with which this operation must be performed, and because of the popular belief that ablation of the uterus and ovaries is followed by serious nervous disturbances that may even amount to insanity. That this notion is very greatly exaggerated is proved by the experience of present-day surgeons. It has been our observation that the artificial menopause causes no more disturbance than does a normal change of life.

The nervous symptoms of the menopause may be divided into two distinct groups, the vasomotor and the psychoneurotic. Vasomotor symptoms are represented chiefly by hot flushes, though there may be other manifestations of dizziness, cold extremities, etc. In our series of cases vasomotor disturbances appeared in 80 per cent. after castration. The average duration of these symptoms is from two to three months, though they may last longer. Painful or irritating complications after operation, such as hernia, postoperative adhesions, wound infections, and, especially prolapse of the cervical stump and vaginal wall, tend to make the symptoms more severe and to prolong them over a greater period of time. Ovarian extract acts as a specific for the vasomotor changes, almost invariably relieving them.

The cause of hot flushes is in some way related to the removal of the ovaries, but in just what way the change takes place is not definitely known. Schickele ascribes them to a heightened blood-pressure, due to the removal of the vasodepressor influence of the ovarian internal secretion. Observations made at the Free Hospital for Women in a series of about 50 cases have failed to reveal a single instance of increased blood-pressure following castration.

That hot flushes are influenced by some other factor or factors is shown by their frequent appearance in women who possess functionating ovaries. In one of our cases, a patient with uterine insufficiency who had suffered severely from hot flushes for several years, the symptoms completely disappeared after hysterectomy and castration.

Vasomotor disturbances do not usually produce nervous symptoms unless they are very severe or frequent, in which case they sometimes react seriously on the nervous system in the same way as any other physical irritant.

Psychoneuroses, as distinguished from vasomotor disturbances, are by no means definitely consequent on the loss of the ovaries. On the contrary, psychoneurotic conditions are again and again relieved or completely cured by a hysterectomy operation which has relieved the patient of some painful irritant like that, for example, of a pelvic inflammation.

Severe psychoneuroses may follow hysterectomy, but they are brought about in the following ways: The operation may have been misdirected and not indicated in the first place, or it may have been improperly performed, or surgical complications may have ensued which have left the patient in a painful, uncomfortable state. As proof of this is the fact that postoperative neuroses following hysterectomy were formerly far more common not many years ago than they are now. This can only be explained on the ground that the technic of the operation has in the last few years been very greatly improved, so that now if it is properly done there is no shock, no postoperative prolapse of the vagina, no pelvic adhesions and other unfortunate complications, which, if present, cause nagging discomforts that are sure to disarrange the nervous mechanism.

Another important cause of the psychoneuroses of the artificial menopause is that resulting from mental suggestion. Under normal conditions a woman does not instinctively suffer a sense of physical degradation from the loss of her pelvic organs, especially if such a loss is attended with a relief of pain. This sense of degradation may, however, be very powerfully induced by the criticism of an unfeeling husband or the suggestions of unwise friends, by which the patient is led to contemplate her inability to bear children or to fear the loss of youth and the premature onset of old age. Under such conditions the mental distress may result in severe psychoneuroses. Such a state, however, must be regarded as due to psychic irritation, and not, in any sense, as a specific consequence of the loss of ovarian secretion.

What has been said concerning the nervous disturbances of the artificial menopause is also true of the physiologic menopause, in which vasomotor and psychoneurotic symptoms may appear. Dubois, after studying many cases for a period of more than thirty years, has come to the conclusion that the neurotic manifestations are largely due to mental suggestion as a result of the cares and worries and apprehensions that are usually incident at the period of the climacteric.

## RELATIONSHIP OF GYNECOLOGY TO THE SEX IMPULSE

A study of the sexual impulse in woman includes a consideration of every period of life from earliest infancy to extreme old age. Until comparatively recent times normal sexual activity was supposed to begin only at the time of puberty and the appearance of menstruation. Before that period manifestations of a sexual character were for the most part regarded as abnormal and as evidence of disease or of some hereditary degenerative taint.

Kisch, in his monumental work on the sexual life of woman, begins at what he terms the menarche (puberty), entirely disregarding childhood. Löwenfeld remarks "that the manifestations of the sexual impulse are not normally present in the days of childhood," and that when the impulse does appear it is either the

result of pathologic conditions that affect the genital organs or of chance impressions or bad example. To Freud must be given the full credit of first recognizing the normality of the sex impulse in childhood and of calling attention to the enormous influence which infantile and adolescent sexuality has on the mental and physical character of the adult. The theories of Freud have not been received without intense opposition, but they have finally come to be so widely accepted, both by the medical profession and by psychologists, that they cannot be disregarded in a work of this kind.

Freud attributes the little value that has in the past been ascribed to the childhood period of sexual development to the universal infantile amnesia which "causes the individual to look upon his childhood as if it were a prehistoric time and conceals from him the beginning of his own sexual life." Freud, however, has been able to show that during the forgotten period of childhood the most important and lasting impressions are made on the childish mind, which, though lying latent and forgotten in the subconscious, actually continue to exert a powerful influence on the qualities and reactions of the individual throughout his lifetime.

In considering Freud's views on infantile sexuality it must be remembered that we are studying the impulse in its various stages of development; that is to say, the sex manifestations of the young child are essentially rudimentary and are in no way equivalent to the physico-psychic sex reactions of the matured individual. Failure to appreciate this fact has led many to regard the Freudian theories with abhorrence. As Trotter puts it, it is like the embryology of the body, which to persons with no biologic training is far from being a gratifying subject of contemplation.

### INFANTILE SEXUALITY

According to Freud the newborn child brings with it rudimentary sexual impulses which normally make their appearance at certain stages of the child's life with intervening periods of latency. These early rudimentary impulses are very complex and, as will be explained later, include perverse as well as so-called natural instincts. The first instinct that the child exhibits is that for nourishment, which is obtained by sucking its mother's breast. The act of sucking, first employed for appeasing hunger, is soon found to be soothing and pleasurable, and the child resorts to it often when not hungry, thereby inducing sleep. The act of nursing, notwithstanding its primary object, is to be regarded as the earliest manifestation of the sexual impulse, a fact not to be wondered at in view of the close association of the hunger and sex instincts that later in life are sufficiently obvious. The pleasurable sensation excited by the act of nursing leads the infant to seek other objects for sucking more accessible than the mother's nipple. This practice, which to a certain extent is universal among babies and is, within limits, physiologic, disappears in time and is harmless. It may, however, become excessive and be the starting-point of serious later developments. The objects

most frequently chosen for sucking are parts of the infant's own body, especially the thumb, the tongue, a part of the lip itself, or the great toe. Associated with the act of sucking there is often a rhythmic pulling of the lobe of the ear, or the rubbing of certain sensitive parts of the body. This habit completely occupies the attention of the child and leads to sleep and sometimes to a reaction resembling an orgasm. That thumb-sucking is a sexual manifestation is often recognized by parents who are vaguely aware that the child is doing something wrong and who strive to break the habit. Such a habit often persists for years, sometimes for a lifetime, and probably in the majority of cases leads directly to masturbation. Freud finds among men a definite relationship between energetic infantile thumb-sucking and a later tendency to excessive drinking and smoking, while among women he shows that it may lead in adult life to certain lip perversions, or, if repressed, to hysteric symptoms connected with eating, such as globus hystericus, choking sensations, and vomiting. Thumb-sucking, which is only one of several examples of infantile sexual activity, illustrates the theory of erogenous zones, a term adopted by Freud from von Kraft-Ebing and defined by the latter as "portions of the skin or mucous membrane in which stimuli produce a feeling of pleasure of definite quality." Examples of these sensitive areas are the lips and mucous membrane of the mouth, the nipples, the anus, the neck of the bladder, the buttocks, and the external genitals. As will be seen later, undue early excitation of any one of these zones may produce an abnormal sensibility of that particular part of the body and evoke in after years certain sexual aberrations from habitual gratification, or neuroses from repression of the unnatural impulse. In habitual thumb-sucking we have an illustration of abnormal stimulation of the lip-and-mouth erogenous zone.

The sexual impulse of the child is essentially auto erotic, that is to say, the sexual aim is directed to some portion of the child's own body, usually one of the erogenous zones. At birth the various zones are each susceptible of developing into predominant sexual areas if subjected to special excitation, a point which will be seen to be of importance in determining some of the perversions. Nature, however, provides that under normal conditions certain zones only shall be stimulated for future sexual activity. Thus the act of nursing prepares the lip zone, so that it plays a prominent part sexually during life. Freud sees in the irritation from uncleanliness, cleansing, chafing, etc., nature's provision for the early excitation of the genital zone. The infant soon recognizes the pleasurable sensibility of this area and learns to repeat the experience by onanism, even during the nursing age. In girls this is accomplished either with the hand or by pressure of the thighs. So nearly universal is this phenomenon that Freud regards it as a physiologic reaction which serves to establish the future primacy of the genital zone. The first phase of infantile onanism is usually of brief duration, though it may continue indefinitely and provide a permanent deviation from normal sexual development.

At about the fourth year in most children there is a second reawakening

of the sexual impulse, and again there is a period of onanistic activity which is also normally of short duration. Both the incidence and duration of this period varies considerably in different individuals. Girls do not escape this experience and there is some ground for belief that both this and the infantile period of masturbation are more common in them than in boys. In the second period the sexual demand in girls is apparently not necessarily determined by local irritation, but may be of central origin. It is characterized by a sudden itching or prurient sensation, often of a disagreeable nature, which is commonly relieved by the hand or by pressure of the body against some projecting object or by bodily movements with the thighs closed. The sensation and its relief may be induced by such exercises as riding a bicycle, swinging, rocking, riding in railroad trains, etc. In its physiologic phase the onanism of childhood is not associated with psychic sexual phantasies.

Freud rightly emphasizes the great importance of the influence of the second stage of childhood masturbation on the future character of the individual. At this period there begins to develop in the child's mind forces which inhibit the sexual impulse and which find their expression in a sense of shame and loathing. This sexual barrier, as it is termed, is not essentially the outcome of parental discipline and education, but, as Trotter has pointed out, is a true instinct. In a normally or, one might say, ideally developing and properly protected child the psychic barrier completely overcomes the masturbatic tendency and there ensues a latent period until the next stage of sexual awakening. During the latent period not only does the psychic inhibition prevent sexual practices on the part of the child, but it inspires loathing at the appearance of such inclinations in other children or in older persons. The normal child is, therefore, to a certain extent automatically protected from the dangers of seduction and enters on the age of puberty well prepared for the serious problems of life.

For many children, however, the latent period is a critical age. If the psychic barrier is weak either from hereditary predisposition or from unfavorable environment, or from both causes working together, the sexual activity of mid-childhood may continue and become intensified. Under such conditions the child is an easy prey to the influences of seduction or evil impressions and the sexual stream may flow readily into some perverted channel. In other cases the psychic barrier, though it may succeed in repressing the sexual impulse, appears too late and brings about a conflict so severe that it leaves in the childish mind a profound traumatic impression which may reappear in later years in the form of some serious neurosis. It is in cases of this kind that Freud has carried out his deepest researches and made his most important discoveries.

Up to the time of puberty the sexes do not differ greatly in regard to their sexual activity, though it may be said that the inhibitive instinct seems to appear earlier and more effectively in girls than in boys. At the beginning of puberty, however, a marked divergence between the two sexes takes place. In the boy very definite and consistent sexual changes take place concomitant with the

rapid development of the genital apparatus. These may be summed up in the appearance of the libido, powerful attraction toward the opposite sex, and a more or less periodic discharge of the sexual products. In normal boys the sexual experience is constant, showing comparatively little variation in different individuals. In girls, on the other hand, the sexuality of puberty is not as well defined. In them the libido is not regularly awakened as a result of the physiologic and anatomic changes of puberty, but depends for its excitation on an external stimulus, such as seduction, love, onanism, suggestion from books, etc. Hence in girls puberty and the awakening of the libido are not necessarily contemporaneous.

The way in which full sexual sensibility is developed may be best understood by the following quotation from Freud:

"In respect to the auto-erotic and masturbatic sexual manifestations it may be asserted that the sexuality of the little girl has entirely a male character. Indeed, if one could give a more definite content to the terms 'masculine' and 'feminine,' one might advance the opinion that *the libido is regularly and lawfully of a masculine nature, whether in the man or in the woman; and if we consider its object, this may be either the man or the woman.*

"The chief erogenous zone in the female child is the clitoris, which is homologous to the male penis. All I have been able to discover concerning masturbation in little girls concerned the clitoris and not those other external genitals which are so important for the later sexual functions. With few exceptions I myself doubt whether the female child can be seduced to anything but clitoris masturbation. The frequent spontaneous discharges of sexual excitement in little girls manifest themselves in a twitching of the clitoris, and its frequent erections enable the girl to understand correctly even without any instruction the sexual manifestations of the other sex; they simply transfer to the boys the sensations of their own sexual processes.

"If one wishes to understand how the little girl becomes a woman he must follow up the further destinies of this clitoris excitation. Puberty, which brings to the boy a great advance of libido, distinguishes itself in the girl by a new wave of repression which especially concerns the clitoris sexuality. It is a part of the male sexual life that sinks into repression. The reinforcement of the sexual inhibitions produced in the woman by the repression of puberty causes a stimulus in the libido of the man and forces it to increase its capacity; with the height of the libido there is a rise in the overestimation of the sexual, which can be present in its full force only when the woman refuses and denies her sexuality. If the sexual act is finally submitted to and the clitoris becomes excited its rôle is then to conduct the excitement to the adjacent female parts, and in this it acts like a chip of pine wood which is utilized to set fire to the harder wood. It often takes some time for this transference to be accomplished, during which the young wife remains anesthetic."[1]

The sexual life of the first part of normal womanhood may be thus recapitulated: The first sexual activity appears in earliest infancy and results from the pleasurable sensations of nursing. It is manifested often by thumb-sucking, masturbation, and other equally significant acts associated with certain areas of the body termed erogenous zones.

A second period of sexuality appears at about the age of four to six and is characterized chiefly by masturbation of the clitoris. This period is under normal conditions of comparatively short duration and is terminated by the development of the psychic barrier, which, supplemented by parental discipline, causes the child to repress the masturbatic practice. After the termination of the onanistic period of childhood the little girl's life is apparently asexual. At puberty

there takes place a fresh wave of repression in contrast to the flood of libido which occurs in boys. The repressive inhibition lasts through maidenhood and may be regarded as a provision of nature in that it furnishes the resistance necessary for the highest effectiveness of the male libido. At the first coitus the normal woman is often anesthetic and may remain so until the clitoris is able to conduct its excitability to the adjacent parts and especially to the vagina. This period of sexual anesthesia may continue for several weeks or months. Occasionally it lasts until after the birth of the first child. This temporary anesthesia of the newly married woman is not to be regarded as pathologic, although it sometimes is the exciting cause of an anxiety neurosis. When full sexual sensibility has been established the libido of woman becomes masculine in type, though between man and woman the component parts of the libido may exhibit variations in intensity. Thus in woman the psychic element is often more powerful than the somatic, as compared with man, though in some instances the conditions may be reversed.

The asexual period of maidenhood described above may be regarded as the ideally normal, and is undoubtedly the best preparation for the later duties of wife and motherhood, in that it makes for greater mental and social stability. The adolescent period is, however, peculiarly liable to sexual interruptions such as may result from multiple love affairs, lax social environment, onanism, evil suggestion, etc. Women who during their maidenhood period experience such interruptions are especially subject to neuroses and are prone later to become irritable and discontented in married life.

During the first part of married life the participation of woman in the conjugal relation is more that of passive acquiescence. After the birth of children and as physical attraction wanes it frequently happens that the rôle of sexual initiative between the partners is reversed. The sexual libido of woman does not cease at the menopause, but may continue indefinitely afterward. During the period of the climacteric there is often an increase in intensity which under pathologic conditions may amount to nymphomania. After the menopause the libido gradually diminishes, more, in all probability, from disuse and repression than from a physiologic disappearance of the emotion.

Libido and sexual sensibility are not, as a rule, destroyed by castration in adult life.

## SEXUAL DEVIATIONS

**Masturbation.**—Of the various sexual deviations to which woman is subject the most important is masturbation, a fact that is not fully appreciated. Not only is its frequency underestimated, but its influence on character and health has received too little attention.

The subject of masturbation is not as well understood in woman as it is in man. Much of the evidence in the literature is vague and contradictory. It therefore becomes necessary to weigh judicially the evidence that is available and with the aid of clinical observations to draw such conclusions as seem most

reasonable. Freud's theories on infant sexuality, cited above, throw a new light on the masturbation of childhood. If these theories be accepted, we must regard as physiologic the brief onanistic periods of the nursing stage and of mid-childhood. These two manifestations of sex activity are practically alike in the two sexes and in no sense indicate degenerative hereditary tendencies. On the contrary, they are a provision of nature to prepare the genital zone for its ultimate sexual primacy, and their failure to appear may even denote an inborn sexual deficiency. If, however, they are not duly checked by the inhibitions which nature also provides, then masturbation becomes pathologic. The persistence of the practice beyond its physiologic limits may indicate an hereditary predisposition or it may be the result of an unfavorable environment. There is no doubt that during the latent period of childhood an occasional infrequent recurrence of the prurient sensation of the clitoris demanding gratification may take place in entirely normal individuals, especially in those who in mature life develop strong sexual impulses. When, however, the recurrence is so frequent as to form an established habit, it must be regarded with concern. Although it is frequently asserted, and probably with truth, that onanism in the adult woman is less harmful than it is in man, the same assertion cannot be made of onanism of the latent period of childhood, for girls are peculiarly susceptible to the abnormal psychic reactions to which the practice leads.

When onanism becomes excessive in a child the condition is a difficult one to combat. In extreme cases the craving is incessant and insatiable. Prevention by tying the hands or by other mechanical means is, for the most part, futile, for orgasm can be accomplished by simple movements of the body. Excepting in cases where onanism is a syndrome of mental degeneracy the onanistic child is frequently prematurely bright and intelligent. When the psychic barrier is entirely inactive the child exhibits no sense of shame and is frank, cheerful, and care free. In this type of case there are often no signs of physical detriment. Such cases, however, must be kept from contact with other children, for in addition to the auto-erotic impulse which leads them to constant masturbation there exists almost invariably a tendency to communicate their experiences to companions either male or female. They become, therefore, a dangerous source of seduction.

The future of the childish victim of uninhibited onanism is not easy to prognosticate. Where hereditary degenerative influences play a part the masturbative tendency may be a prodrome to some later serious psychosis. In other cases the onanistic impulse which during childhood is auto-erotic may become frankly altruistic, that is, directed to others of the same sex. In this way the child may develop sooner or later into an invert or homosexualist. Such individuals may be entirely normal in every other way and often show great intellectual power and productiveness in mature life.

In still other cases the normal repressive reaction of female puberty may check the onanistic tendency, and under proper environmental influences the

sexual stream may eventually be directed into normal channels, though neurotic stigmata are comparatively certain to appear.

So far we have discussed what we have chosen to term the "uninhibited masturbator," that is to say, the child in whom the psychic barrier of shame and self-reproach has failed to act.

There is another important type, where the psychic barrier, though strong, only incompletely overcomes the sexual impulse. The result is a continual mental conflict which, as Freud has shown, may lay the foundation of a later neurosis. Individuals of this type often suffer more physical detriment than do those of the uninhibited class. They are frequently meager and sallow in appearance, subject to digestive disturbances, non-resistant to disease, mentally sluggish and apathetic, secretive, and antisocial. Between the two extremes of type there are all gradations. From the time of puberty to the time of female maturity, usually estimated at nineteen, masturbation is not physiologic, as to a certain extent it may be regarded in boys. If habitual masturbation occurs in the adolescent girl it is either a continuation of abnormal childhood onanism, or if it appears for the first time, it is the result of a prematurely stimulated but ungratified sexual activity. What has been said of masturbation of the latent period of childhood may be applied for the most part to the period of adolescence with some modifications. When the habit is excessive it is usually associated with some mental disorder. Patients of this kind often suffer from severe and extensive vulvitis as a result of manipulative irritation (see Vulvitis). Newly acquired masturbation at this age usually does not lead to serious results.

Early masturbation is a poor preparation for married life, for those addicted to the habit are apt to be anesthetic in normal coitus. This is explained by the fact that continued excitation of the clitoris causes a fixation of sexual sensibility to that particular zone. When, therefore, normal coitus takes place the clitoris permanently refuses to give up its excitability to the zones of the vulva and vagina, which play an absolutely essential part in complete natural orgasm. Thus masturbation continued from childhood is rightly classed as an infantile fixation, and is comparable from a neurologic standpoint, though not necessarily concomitant, with those anatomic fixations which are so common in the female pelvic organs.

Early continued onanism has an important influence on the character of woman, for in addition to the neuroses which it induces it is extremely apt to be instrumental in fixing certain traits of disposition that belong essentially to childhood. The infant is not only sexually auto-erotic, but is also otherwise psychically egocentric. We have seen that the auto-erotic tendency of mid-childhood is soon checked by the development of the psychic barrier which creates feelings of shame and self-reproach. This psychic barrier is, in reality, the herd instinct which by antagonizing selfish impulses adapts the individual to social surroundings. If the psychic barrier is incapable of checking the auto-erotic tendency as is manifested by continued masturbation it may fail also to

check other egocentric impulses not essentially sexual, such as jealousy, cruelty, dependence, and self-will, which are characteristic of the infant's nature. Thus, traits of this kind may become fixed, and individuals who exhibit them in mature life are said to be subjects of *psychic* infantilism. Psychic infantilisms of character are not necessarily conditioned on early masturbation, though it is probable that when they are well marked they are usually the stigma of some early sexual irregularity.

The prevalence of masturbation in matured women is problematic, but it is undoubtedly far more common than is generally supposed. Gutceit is of the opinion that after the age of nineteen or twenty "sexual self-gratification is almost universally practised by women, even if it be not always practised to excess," but the statement probably is an exaggeration. It is impossible to secure exact data concerning the onanism of maturity, as women are habitually secretive and deceptive on this subject. From what evidence we have we are led to believe that women who have indulged in the habit in earlier life beyond the physiologic limit, either continue or resume it to a greater or less extent after the age of maturity. This must be especially true in women who do not achieve normal sexual gratification or in those in whom the early practice has by fixation prevented the extension of sexual sensibility from the clitoris to the neighboring erogenous zones (vulva and vagina).

How often masturbation is acquired for the first time after maturity it is impossible to say, but it may be conjectured that in cases where gratification is lacking from impotence or indifference on the part of the husband, it is frequently resorted to as a means of relief.

Hence we are brought to the conclusion that after maturity onanism is more common in women than in men, for in the latter it is a comparatively rare habit after the age of twenty-five.

It is a matter of significance that the adult woman rarely consults a physician for advice in this matter. From this fact it must be concluded that if onanism is common in the middle period of life it is not at this time especially productive of obvious harm, certainly not in comparison with the onanism of youth. There is the best authority for the statement that the onanism of adult woman is much less detrimental both psychically and somatically than in adult man. Hitschmann states that "there is a special sexual constitution which causes certain people to become ill as a result of masturbation, while others bear their onanism without noticeable injury." It is important not to depreciate the possible harm that excessive masturbation may do even in matured life. The evil results are seen mostly in psychoneurotic reactions and are more familiar to the neurologist than to the gynecologist.

The onanism of woman, as a rule, produces no observable somatic changes, yet in some cases objective signs are definite. Of these, the most common is a lengthening and attenuation of the labia minora. The change is usually asymmetric. Sometimes only one labium minus is affected. This deformity we are inclined to think is the result of some special onanistic technic by which the

labia become gradually stretched. It may, however, be analogous to the lengthening and relaxation of the scrotum characteristic of the male masturbator. The severe vulvitis from excessive onanism is described elsewhere. Other somatic changes are the result of continued pelvic congestion. There is no doubt that some of the cases of severe menorrhagia in young girls after puberty have their origin in masturbation, though on this point we have had difficulty in our personal experience in securing reliable data. In a typical extreme case the uterus is much enlarged and usually retroverted. There is a marked permanent gland hypertrophy. Menorrhagia is severe and prolonged.

In an extreme case observed by us of a girl of ten, marked dilatation of the superficial venous capillaries of the thighs and lower abdomen were noted. How common this is we do not know, as we have not seen it mentioned elsewhere.

It is quite probable that masturbation may in some cases be the primary or contributing cause of the frequent condition of varicocele of the broad ligament in the same way as in the male it often leads to scrotal varicocele.

**Dyspareunia.**—Like masturbation, dyspareunia is a subject the importance and frequency of which has not been adequately estimated in the study of the physical and mental welfare of woman. The word *dyspareunia* is commonly misused as a synonym for painful coitus. In its strict sense it denotes a condition in which, though the libido sexualis is present, normal orgasm is not produced by intercourse. Dyspareunia may be the result of pain, but pain is not a necessary accompaniment and, except in a certain class of cases, is absent. Sexual anesthesia, frigidity, and anaphrodism are terms sometimes used equivalent to dyspareunia.

*Sexual anesthesia* is used differently by different authors. Freud employs the term as we have used it above as synonymous with dyspareunia, *i. e.*, local inexcitability, libido sexualis being present. Von Kraft-Ebing, on the other hand, uses the term to denote complete asexuality, with entire absence of libido. Such a definition implies an organic affection of the nerve centers, such as may arise from disease of the brain or spinal cord, diseases of the endocrine glands, marasmus, diabetes, morphinism, alcoholism, and sexual abuses. We prefer to use the expression in the Freudian sense.

A complete understanding of the causes of dyspareunia would imply a knowledge of the mechanism of sexual excitability. Such knowledge we unfortunately do not possess and we must rely for guidance only on certain vague theories. The nerve theory may be briefly stated as follows: coitus stimulates the sensory nerves of the clitoris, the vulva, the vestibule, and the vagina; this stimulus is communicated to the cerebral cortex where it gives rise to pleasurable sensations; from the cerebral cortex is produced a reflex stimulation of the genitospinal center, which in turn excites a series of reflex discharges in the genital organs, the most notable of which are the erection of the clitoris and the ejaculation of the secretions of various glands.

Such an explanation is incomplete, for it does not take into account the influence of the internal secretions of the body which undoubtedly play an important part in the reactions of all psychic emotions. A definite connection between sexuality and the endocrine glands is extremely probable, but not as yet under-

stood. The ovaries, at one time thought to be the very seat of sexuality, are now known to occupy a secondary position, while the sexual influence of the other glands of internal secretion is entirely problematic. Freud emphasizes the importance of the chemical theory of sexuality and furnishes the following hypothesis:

"Through the appropriate excitement of erogenous zones as well as through other conditions under which sexual excitement originates a material which is universally distributed in the organism becomes disintegrated, the decomposing products of which supply a specific stimulus to the organs of reproduction or to the spinal center connected with them. Such a transformation of a toxic stimulus to a particular organic stimulus we are already familiar with from other toxic products introduced into the body from without."

Acknowledging the inadequacy of both the nervous and chemical theories of the mechanism of sexuality we shall for the sake of convenience adopt the following classification of Kisch of the fundamental causes of dyspareunia:

1. Insufficient or completely wanting peripheral stimulation of the sensory nerve terminals in the female reproductive canal. This implies a failure of conduction of the stimulus to the nerve centers.

2. Inhibitory influences proceeding from the cerebral cortex whereby pleasurable sensations and perceptions are checked.

3. Diminution or cessation of the excitability of the reflex center in the spine (genitospinal center). This leads to failure of the sense of ejaculation.

This forms a workable, though from the viewpoint of the chemical theory perhaps not a truly scientific, classification. It may be summed up by saying that dyspareunia may be the result of (1) failure of local sensibility, (2) failure of a central pleasure sensation, and (3) failure of discharge.

Although we have adopted the essential classification of Kisch, we shall not follow his grouping of specific conditions.

Under the first heading, *i. e.*, lack of local sexual sensibility, we must include primarily that condition mentioned above and suggested by Freud in which the clitoris refuses to give up its excitability to the surrounding erogenous zones of the vulva and vagina. Freud, we have seen, believes that this failure when temporary is physiologic and usually ensues for a variable period of time after defloration. If the anesthesia of the vagina and vulva remains permanent Freud believes that it is frequently the result of early masturbation by which the clitoris as a consequence of overstimulation becomes incapable of sharing its power of excitation with the neighboring areas. It is not unlikely that the anesthesia may persist in many cases where there has been no masturbatic agency and even no clitoris excitability. In such a case it might be impossible to judge whether the anesthesia were due to a congenital sensory deficiency of the peripheral nerves or to some psychic inhibition dating from early childhood except by a skilful and searching psycho-analysis. The diagnosis of such a case would be important, for if the condition were due to congenital nerve deficiency it would be incurable, whereas if it were the result of psychic repression it might under proper treatment be cured.

Under heading 2 (*i. e.*, failure of a central perception of pleasure) there are numerous specific causes for dyspareunia. Important among these are the cases in which local pain plays a part. Kisch groups these cases under heading 1, but it seems more reasonable to us to classify them with cases of psychic inhibition, for the sensation of pain arrives first at the cerebral cortex and checks the pleasure sensation which without the pain would have been perceived. The anesthesia accompanying defloration may be entirely due to the pain of breaking the hymen, for undoubtedly full sexual sensibility sometimes occurs as soon as the lacerated part is entirely healed, though this is probably not the rule. Any anatomic condition of the genital tract which produces painful coitus may be a cause of dyspareunia. The most frequent of these causes are pelvic inflammatory processes of all kinds, acute or chronic, various inflammations of the vagina, cicatrices of the vaginal wall, tumors of the pelvis or vagina, inflammation of any part of the vulva, especially Bartholin's glands, urethral caruncle, cicatrices of the perineum, vesicovaginal and rectovaginal fistula, etc. The frequency with which pain is associated with dyspareunia has led to the misuse of the term as equivalent to painful coitus.

Closely connected with pain as a cause of dyspareunia is the fear of pain. This is a purely psychic inhibition. The anesthesia which normally follows defloration may be of this nature. There is no doubt that some of the permanent cases of dyspareunia are the result of the physical and mental shock induced by an inconsiderate partner at the first coition. Thus dyspareunia is allied to vaginismus.

Other very important causes of dyspareunia are the psychic repressions in the strict Freudian use of the term. These are the result of early childhood fixations which may be brought about in various ways. Thus some accidental sexual experience of childhood, the so-called sexual trauma, may engender a sense of disgust for things sexual so profound and lasting as to act as a psychic barrier through life.[1] Or the fixation may be the result of an early psychic conflict with sexual impulses by which the psychic censor becomes permanently dominant.

Freud emphasizes as an important factor in dyspareunia the prolonged attachment of a daughter to her father. In these cases sexual sensibility becomes permanently repressed, and when marriage takes place normal sexuality cannot be awakened nor can the psychic affection be transferred from father to husband. More or less serious neuroses are apt to ensue. A similar result often follows long-continued interdependence of a mother and daughter.

Dyspareunia may be the temporary result purely of emotional inhibitions, such as grief, worry, fear, indifference to or hatred of partner, etc. Such a condition may be called relative dyspareunia. In woman local sexual sensibility is much more dependent on psychic affection than in man. It sometimes happens that a woman who in the first years of marriage is normal sexually, later acquires partial or complete anesthesia. In the absence of some organic disease or func-

[1] The effect of such a sexual trauma is well told in the popular story "The Dop Doctor."

tional changes in the endocrine glands this is in most cases due to a growing lack of sympathy between the partners.

Psychic inhibitory dyspareunia is occasionally the result of inversion in cases where the homosexual inclination is so strong that normal coition is distasteful.

Under the third division of the causes of dyspareunia we group those cases in which local sensibility and psychic perception of pleasure are present, but where from lack of irritability of the genitospinal center the final orgastic discharge is not completed. This is an extremely common complaint among women, and one which frequently leads to neurotic disturbance. In some cases there is an undoubted inherent deficiency in the excitability of the reflex spinal center. In a large percentage of cases, however, it is the result of incomplete coition, such as is represented by coitus interruptus, impotence and premature ejaculation of the male, various methods of preventing conception, etc.

There are certain pathologic conditions in which the local and psychic irritability is intense, without the possibility of complete gratification. Patients suffering from this trouble are in a continuous state of unsatiated erethism. They constitute the class of nymphomaniacs and incessant masturbators and are subjects usually for the psychiatrist.

Dyspareunia most commonly comes to the notice of the gynecologist as a complaint of women who seek relief from sterility. There is no doubt that there is some etiologic connection between the two conditions. Kisch found that in 69 sterile women 38 per cent. were dyspareunic, though he does not state whether other causes of sterility were present. Although impregnation may take place in frigid women, or even in those who have been narcotized, nevertheless it is probable that for normal fertility full sexual sensibility is necessary. Some of the mechanisms incidental to impregnation are purely sexual reactions, such as the activity of Bartholin's glands, the secretion of the cervical mucous crypts, the aspirating movements of the cervix, and the reflexes of the vaginal canal by which the semen is retained. These mechanisms, though not absolutely essential to impregnation, certainly favor conception. They are for the most part inactive in the dyspareunic woman.

## RELATIONSHIP OF GYNECOLOGY TO THE NEIGHBORING ORGANS

The genitalia bear a close relationship to the neighboring pelvic organs, both physiologically and pathologically, as would be expected from their intimate anatomic proximity. Under normal conditions the bladder possesses a firm attachment to the anterior wall of the uterus, and the uterus rests directly on the vertex of the bladder, so that the movements of each organ have an important influence on the position of the other. The filling and emptying of the bladder may cause a difference of as much as 90 degrees in the direction of the axis of the uterus, while changes in the plane of the uterus from abdominal pressure produce a corresponding change in the upper pole of the bladder.

The ureters pass through the parametrial tissue close to the sides of the cervix and immediately underneath the uterine vessels, so that they are readily influenced by pathologic disturbances of the parametrium, or by uterine and intraligamentary tumors, the effect of the interference being transmitted directly to the kidneys with significant results. The proximity of the ureters to the uterus constitutes one of the most important dangers in the performance of deep pelvic surgery.

Behind the uterus lies the rectum, which when filled with fecal matter may alter to a considerable extent the position of the uterus, while retrodisplacements and tumors pressing on the rectal wall may influence in an important manner the rectal function. The rectum and intestines play a serious rôle in the pathology and symptomatology of pelvic inflammatory disease, as does also the peritoneum. The appendix is another neighboring organ which must be reckoned with in numerous gynecologic conditions.

**The Bladder.**—In association with pathologic changes of the position of the uterus the bladder may undergo marked dislocations or alterations of form. In upward displacement due to pressure of a tumor below, the vertex of the bladder is also carried upward, but such a change does not always produce vesical symptoms. Backward displacement of the uterus (retroversion, retroflexion) does not greatly change the position of the bladder, though there may be a slight drag at the point of the uterovesical attachment. This, however, is not sufficient to produce vesical irritation, at least to the extent formerly supposed. Downward displacement or descensus of the uterus, on the other hand, has a very important effect on the bladder, for this is the chief factor in the production of cystocele. Cystocele not only causes symptoms of pelvic pressure, but, as it represents a pouch or diverticulum of the bladder which cannot easily be evacuated, the stagnant urine predisposes the bladder mucosa to infection and cystitis.

When pressed upon by pelvic tumors the bladder displays a remarkable mobility and adaptability to new positions. Overlying tumors may press it deep in the pelvis, and underlying tumors may force it far up on the abdominal wall or to one side, while the pregnant uterus may compress it in the center and cause bilateral dilatations of the walls. In the presence of great retroperitoneal tumors the bladder may be distorted into the most bizarre shapes. In many of these cases, even of marked pressure or displacement, the bladder shows surprisingly little evidence of irritability. Conditions of displacement, however, predispose the bladder to infection and irritation, the effects of which may be clinically very important. During pregnancy the uterus, if in the forward position, may produce frequency of micturition by pressure of the overlying fundus, while, if the fundus is retroflexed, the cervix may press on the neck of the bladder and cause interference with urination or incontinence. Impacted retroflexion may so obstruct the vesical neck as to result in complete retention (ischuria paradoxa). At childbirth the general congestion of the pelvis in which

the bladder wall takes part predisposes to cystitis, which is frequently excited by the necessity of catheterization. Injuries of the bladder are often caused by labor, as a result of crushing pressure against the pubes or of rough instrumentation, by which the vesicovaginal septum is either torn or suffers necrosis with consequent fistula. The injury which the bladder undergoes during labor often results in damage to the vesical sphincter, so that it becomes incompetent and the patient suffers functional incontinence.

In inflammatory processes of the genitalia the bladder is often implicated. Gonorrheal pelveoperitonitis, as is mentioned several times elsewhere, is usually confined to the posterior segment of the pelvis, but it may be so extensive as to involve the anterior half and the bladder. Septic processes of the different pelvic organs sometimes form adhesions to and rupture into the bladder, examples of which are tubal, and ovarian abscesses, necrotic tubal pregnancies, ovarian dermoids, and purulent diverticula of the sigmoid. Parametritis following supravaginal hysterectomy or a septic puerperium usually involves the bladder in a temporary cystitis, and, conversely, extensive deep-seated cystitis sometimes involves the parametrium.

Cancer of the vagina does not implicate the bladder until late in the disease, chiefly because it usually originates on the posterior wall. Cancer of the uterine cervix, however, frequently extends to the bladder, though it also invades the wall comparatively late. Vesical and genital tuberculosis are curiously independent of each other, an affection of either tract having no tendency to extend to the other.

There is a vague relationship between genital psychoneuroses and the function of the bladder, but it is not specific, and probably does not differ from nervous disturbances from other causes.

**Ureters.**—The influence of the genitalia on the ureters is exerted by disturbances which mechanically compress or dislocate them so as to interfere with the normal flow of urine from the kidneys.

Partial obstruction with hydro-ureter is sometimes seen in autopsies on pregnant women. This, according to Opitz, is not the result of direct pressure, but is thought to be due to hyperemia and edema of the ureteral mucous membrane. Rarely parametrial exudates result in scars about the ureters, which become constricted by the shrinking process of the tissue, with consequent hydro-ureter or hydronephrosis.

The ureters are affected chiefly by the retroperitoneal tumors, such as intraligamentory fibroids and ovarian cysts, which, if they reach any considerable size, invariably dislocate the ureters from their normal position, a fact that must be borne constantly in mind while operating on these tumors.

Cancer of the cervix ultimately invades the parametrium and surrounds the ureters, sometimes constricting or occluding them, but not often invading the ureteral wall itself. This implication of the ureters constitutes one of the chief dangers and difficulties in the radical operation for cervical cancer.

The ureters are often injured during deep pelvic operations, with resultant fistulas.

Affections of the ureter often give symptoms of pain, which are referred to the pelvic organs, causing incorrect diagnoses and ill-judged operations.

Of these affections the most important are stone and the so-called Hunner stricture (*q. v.*).

The relationship between the genital organs and inflammatory conditions of the *peritoneum* and *intestines* is dealt with at length in a special section (see page 155).

**Rectum and Sigmoid.**—The rectum must be taken into account in a great many gynecologic conditions. Most common of these is the rectocele which follows lacerations of the perineum, and which usually accompanies prolapse of the uterus and cystocele. Rectocele often interferes with proper defecation, and is an annoyance to the patient on account of the sense of protrusion from the vagina. Rectocele of itself, however, as a rule, causes few subjective symptoms if the uterus and bladder are not prolapsed. The repair of rectovaginal fistula and complete laceration of the sphincter is an important department in the reconstructive surgery of injuries due to childbirth.

Hemorrhoids bear a very significant relationship to pregnancy and labor. The pressure and stretching to which the sphincter is subjected at labor often causes hemorrhoids or aggravates small ones already existing, leaving the veins in a permanently enlarged and sometimes fissured condition. Laceration of the perineum relaxes the tissues about the sphincter, so that the hemorrhoidal veins cease to have proper support and become permanently dilated. Repair of the perineum usually cures the hemorrhoids. Severe puerperal parametritis may involve the rectum in a manner to constrict its lumen, even to complete occlusion, as has been reported in a few cases.

The effect on the rectum of the retroverted uterus is a subject of some controversy. It is often stated that the retroflexed uterus in the course of time becomes adherent to the rectum. It is not likely that simple contact with the peritoneum covering the rectum causes adhesions. It is probable, however, that a heavy uterus, especially one containing a fibroid in its posterior wall, can interfere with the normal rectal peristalsis, and that the stasis thus produced may cause an inflammation in the rectal wall which is communicated to the peritoneum. This process may take place as a result of constipation even when the uterus is not retroverted, a painful and intractable condition, termed "posterior parametritis." It is not unlikely that in some cases the parametritis is primary and causes a retroflexion by the traction of adhesions on the posterior wall of the uterus. Posterior parametritis, with adhesions between the uterus and posterior uterine wall, is not infrequently caused by the ill-judged use of pessaries.

The relationship of the rectum to acute inflammatory conditions of the pelvis is detailed elsewhere. Suffice it to say here that tubal and ovarian abscesses not infrequently rupture into the rectum, causing fistulas that some-

times heal spontaneously and sometimes remain permanent. It should also be repeated that many of the pelvic abscesses of the gonorrheal and tubercular type owe their severity to a mixed infection caused by adhesions to the rectum and migration through the rectal wall of intestinal micro-organisms into the abscess cavity.

Carcinoma of the cervix in its late manifestations invades the rectum and often causes fistulous openings. Cancer of the vagina also invades the rectum, but only when in advanced stage. On the other hand, low cancer of the rectum involves the vaginal wall comparatively early.

In severe pelvic operations, especially where there are extensive adhesions, the rectum figures prominently, for it is very readily injured. Actual tears in the rectal wall can usually be sewed up with little difficulty, and, if care is taken, do not often result in fistulas. Most fistulas occur after injuries which damage the rectal wall only partially and which escape the notice of the surgeon. If gauze drainage is placed in contact with one of these lesions a fistula is inevitable. For this reason gauze should never be used for drainage in the abdominal cavity. Postoperative fistulas of the rectum, whether they lead to the abdomen or vagina, usually heal spontaneously in time, though not always.

The symptomatology of affections of the rectum gives the false idea that the lesions have their seat in the genitalia and thus leads to wrong diagnosis. This is especially true of acute diverticulitis of the lower sigmoid or upper rectum, which may present a picture very like that of a tubal abscess. The pains of chronic colitis are often referred to the tubes and ovaries, and patients sometimes undergo needless operations from this mistake.

**Appendix.**—The anatomic position of the appendix peculiarly predisposes it to complication in affections of the pelvic organs, especially those of an inflammatory nature. Under normal conditions, the tip of the appendix usually lies in the pelvis, near the right tube and ovary, while in cases of ptosis or cecum mobile the appendix may lie completely in the pelvis, even so low as the floor of Douglas' pouch. Between the base of the appendix and the hilum of the ovary there runs a fold of peritoneum, called the "appendiculo-ovarian ligament," that is usually only rudimentary or not demonstrable, but often quite definite, in which it has been claimed run connecting lymph-channels between the appendix and the adnexa. This lymph connection has been denied.

Sympathetic relationships between the appendix and the pelvic organs are based chiefly on inflammatory processes. Tumors of the ovaries may push the cecum and appendix to abnormal positions, and occasionally, though rarely, cause disturbance.

Severe inflammations of the tubes do not exhibit a special tendency to implicate the appendix, the result, doubtless, of gravity, which is effective in keeping the inflammatory products in the posterior and lower part of the true pelvis. The appendix, however, is sometimes involved in the adhesions of a salpingitis. In this case the inflammation imparted to the appendix is external and shows

microscopically as a peri-appendicitis, but there is little danger from this complication of causing an acute dangerous appendicitis. The adhesions which form about the appendix immobilize it and predispose it to later attacks of acute appendicitis, at the same time causing symptoms of chronic inflammation.

On the other hand, acute appendicitis with purulent exudate is very prone to involve the right tube and even the whole pelvis, for gravity carries the products of inflammation to the pouch of Douglas and is thus instrumental in the infection of the adnexa. In this way acute purulent appendicitis in young girls often causes very serious damage to the genital organs in the adhesions and closure of the tubes, adhesion and retroversion of the uterus, and chronic thickening of the cortex of the ovaries. If the attack occurs before puberty or in young girlhood it may prevent full genital development and result in infantilism, with its symptoms of amenorrhea or dysmenorrhea, neuroses, and sterility. Acute appendicitis occurring after maturity may, by its damaging influence on the genitalia, cause sterility, extra-uterine pregnancy, and displacements of the uterus.

Very frequently chronic appendicitis and chronic salpingitis are found associated together, where the two conditions have originated entirely independently of each other. Chronic appendicitis is extraordinarily common in women, though it often exists without any appreciable symptoms. At least 60 per cent. of appendices seen at autopsies, and removed as a routine procedure during abdominal operations, show either gross or microscopic evidences of inflammation. Some even regard a certain amount of chronic inflammation of the appendix as *physiologic*. Such a theory, however, should not be harbored, and the appendix must be regarded as a dangerous and useless organ to be removed as a routine during those abdominal operations in which the expenditure of the few extra minutes required for its removal cannot be considered detrimental to the patient.

There is a very definite relationship between chronic appendicitis and menstruation. The premenstrual and menstrual hyperemia aggravates inflammatory conditions of the appendix region as it does those of the pelvis, so that patients with chronic appendicitis almost invariably feel the pain more at the menstrual period, while many experience it then and at no other time. Moreover, attacks of acute appendicitis often have their starting-point at the time of menstruation.

The course of appendicitis during pregnancy and childbirth is a subject of considerable moment. It is not probable that pregnancy predisposes to an initial infection of the appendix, but there is no doubt that in the presence of a latent appendicitis pregnancy predisposes to recurrent attacks or to lighting up the infection into one of acute activity. Numerous factors naturally contribute to this effect. Stretching and pulling of a spiral or kinked appendix and tearing of old adhesions may be caused by the growing uterus (Wagner). Moreover, the increased constipation during pregnancy, and the venous congestion of the pelvis and abdominal organs, constitute conditions favorable to

inflammation of the appendix. In the mild types of appendicitis the course during pregnancy does not differ essentially from that seen in non-pregnant women, but, if perforation or suppuration takes place, the danger of fatal peritonitis is very much greater in pregnancy. The explanation of this is that the cecum and appendix are forced from the protected recess in which they normally lie, forward and upward into the free abdominal cavity. The omentum is prevented from performing its usual walling-off service by the intervention of the gravid uterus, which tends to keep it in the left side of the abdomen. The collection and isolation of the inflammatory products in the pelvis, which is usual in the ordinary case of acute appendicitis, is impossible during pregnancy because the pelvis is filled with the gravid uterus. Hence it will be seen that the peritoneum during pregnancy is especially exposed to general infection from a suppurating process of the appendix.

Still more dangerous is an acute suppurative appendicitis that occurs at the time of labor, or an appendical abscess that by its attachment to the uterine wall, precipitates a premature delivery. Here the sudden diminution in size of the uterus and the general change that takes place in the position of the abdominal organs rends the protecting adhesions, and causes a discharge of pus into the free peritoneal cavity, a disaster which surgical operation seldom remedies.

In sum, it may be said that a chronic or subacute appendicitis has during pregnancy a predisposition to become acute, and that if suppuration and abscess formation or perforation take place the danger of general peritonitis is considerably increased by pregnancy and very much increased by labor, whether it be at term or premature. Immediate removal of the appendix on suspicion of inflammation is, therefore, always advisable during pregnancy. It may be said that the operation is only rarely followed by abortion if the appendix is in the catarrhal or chronic stage of inflammation.

## RELATIONSHIP OF GYNECOLOGY TO THE GALL-BLADDER

Between diseases of the pelvis and those of the gall-bladder there exists no direct or indirect causal relationship, excepting in the possible metastasis from one region to the other of malignant growths. There are, however, numerous ways in which disturbances of the gall-bladder require very serious consideration on the part of the gynecologist. In every routine abdominal examination the gall-bladder must never be overlooked, especially when there is any complaint of right-sided pain or of vague symptoms in the upper abdomen. During an active attack of adnexal or gall-bladder disease a differential diagnosis is a simple matter, but if active pain is not present at the time of examination, and the examiner must rely to a great extent on the story of the patient, the diseases are not infrequently confounded, notwithstanding the comparative remoteness from each other of the two regions. The difficulty often encountered, even by the most experienced, in the differentiation of chronic disease of the gall-

bladder and that of the appendix is familiar to every practitioner. Even more difficult to distinguish from chronic affections of the gall-bladder are the conditions arising from the obstructing adhesions to which the ascending colon is so frequently prone.

The presence of gall-bladder changes associated with pelvic disease is very often manifested by vague feelings of distress of the upper abdomen of the digestive character, which, as Clark emphatically states, must not in any sense be regarded as reflex symptoms originating in the pelvic lesion. Concomitant symptoms of this kind in gynecologic cases must be given much weight, a large percentage of them when properly interpreted indicating the presence of gall-bladder disease, in contrast to affections of the duodenum and pylorus which in gynecologic practice are comparatively uncommon (Clark).

Patients suffering from symptoms in the gall-bladder region alone are not, in the strictest sense, within the sphere of gynecology, nevertheless they very frequently consult the gynecologist, who is required to make an accurate abdominal diagnosis.

Of chief importance to the pelvic surgeon is the discovery of gall-stones during the routine intra-abdominal examination which should be made, when feasible, in the course of every pelvic operation.

Cases of this kind may be divided into two classes, those in which the history of the patient gives more or less evidence that the gall-stones have caused symptoms, and those in which the presence of the stones is entirely unexpected. In the first class of cases the treatment is obvious, namely, appropriate surgical treatment of the gall-bladder at the time of the pelvic operation, if the conditions permit without undue danger, and if such is not the case, recommendation to the patient of a second operation at some later date.

In the second class of cases in which the gall-stones are incidentally found without previously recognized symptoms the question of treatment is less simple to decide, and numerous considerations must be taken into account, most important of which is the pathologic significance of so-called symptomless cholelithiasis. The fallacy once held that a large percentage of gall-stones are entirely innocuous has of late years been exposed, especially by the work of J. G. Clark, who in writing on the subject has repeatedly called attention to the fact that "in the majority of cases of cholelithiasis micro-organisms of a more or less pathogenic nature are found, and that under these circumstances many vague symptoms, usually attributed to gastro-intestinal or general constitutional disturbance, may arise as the result of toxins elaborated about these foreign bodies (stones) in the gall-bladder."

In considering the patient's history, therefore, with a view to the treatment of incidentally discovered gall-stones, the absence of the classical symptoms of gall-stone attacks does not by any means indicate that the presence of the stones has been symptomless. Our present knowledge of cholelithiasis indicates that the affection should always be regarded in a serious light, and that the removal of the stones is at least desirable. The question of immediate

surgical interference during the course of a pelvic operation must be decided by certain individual considerations. The extra operation involves no very great hazard, as Clark estimates the mortality of cholelithotomy in a large series of cases at 2 per cent. On the other hand, in the type of pelvic operations in which an incidental cholelithotomy could be considered, namely, those excluding cancer of the uterus and severe pelvic inflammation, the mortality would be less than 1 per cent. The extra operation on the gall-bladder, therefore, at least doubles the risk of the primary operation to which the patient has submitted herself. This added risk to the life of the patient, small though it is, must not be disregarded by the surgeon, especially if the primary operation has been a severe one, or if the patient has expressly stated that she wishes to undergo no extra risk. Gall-bladder surgery entails a greater danger, both of postoperative pneumonia and of sepsis, than do the pelvic operations in conjunction with which the gall-bladder operations may be performed; moreover, there can be no doubt that even a simple cholecystotomy must be more dangerous when done conjointly with another abdominal operation than when performed alone. In addition to the added risk to life of cholecystotomy, one must also take into account the inconvenience and possible long persistence of drainage from a gall-bladder wound, which some patients resent who have submitted themselves to a minor pelvic operation. It must be remembered, too, that gall-stones, though usually harmful to the patient's health, are, nevertheless, in the majority of cases, not fatal.

In view of all these considerations, we are rather conservative in the matter of operating at once on gall-stones found during a pelvic operation unless conditions are simple, and prefer in the greater number of cases to state the condition to the patient during her convalescence, and to operate with her consent at a later date when she has fully recovered from the primary operation. The problem is greatly simplified by making it a routine practice to explain to the patient before a pelvic operation certain complicating conditions that may be encountered unexpectedly, and to gain consent to do that which, in the mind of the surgeon, will be of greatest benefit to future health. With nervous or ignorant patients this must be done with tact in order not to give them unnecessary alarm. With a certain class of patients it is advisable to have the consent in writing.

The gall-bladder should always be examined as a routine measure during pelvic operations, excepting when it is important to make an incision so small as not to admit the hand, or when there is sepsis present. In the latter case the danger of spreading infection to the upper portions of the peritoneal cavity is obvious. Palpation of the gall-bladder from a low median incision requires accurate anatomic knowledge of the upper abdominal region and expertness of touch, for it is often difficult to differentiate a collapsed gall-bladder from a loop of small intestine.

If gall-stones are found, and it is decided to remove them at once, it is a temptation to perform the operation with the left hand in the abdomen to

guide the incision and to hold the gall-bladder up into the wound from below, from which position the gall-stones can be pressed out with the greatest ease. This simple and rapid method of doing the operation is, however, fraught with danger, for it is almost impossible to avoid soiling the fingers with bile, so that when the hand is withdrawn from the lower wound there is danger of infecting the intervening peritoneum. The safest method is to complete the pelvic operation and to apply an efficient protective dressing to the abdominal wound. The operation for gall-stones is then performed with every preparation as if it were the initial operation, especially with regard to the position of the patient, which is important, for it is not possible to foretell the extent of the operation until the gall-bladder is exposed. The type of operation must be determined by the surgical judgment of the operator. In the simplest cases the so-called "ideal operation" of removing the stones and closing both the wound in the gall-bladder and that of the abdomen involves some risks. A safer method of treating the very simple cases is to close the gall-bladder, but to leave through the abdominal wound a small cigarette drain. The classic and safe method in the average uncomplicated case is to drain the gall-bladder, the wound from which should, under right conditions, close in two or three weeks, but unfortunately the period of closure is frequently considerably longer than this. When complications are present, cholecystectomy is the operation of choice, indications for which are changes in the wall of the gall-bladder, by which it has become thick and indurated, or thin and distended, or by which the mucosa has undergone ulcerative and inflammatory processes. Chronic inflammation of the mucous membrane is manifested by the well-known "strawberry mottling" appearance. Adhesions about the gall-bladder and stricture of the cystic duct are other indications for cholecystectomy. A discussion of the more serious complications of the hepatic and common ducts does not properly come within the sphere of this book.

## RELATIONSHIP OF GYNECOLOGY TO THE PERITONEUM AND OMENTUM[1]

A knowledge of the physiology and pathology of the peritoneum is of extreme importance, for not only is a large part of the symptomatology of pelvic disease referable to affections of the peritoneum, but it is on its natural plastic properties that the surgeon depends for some of his reconstructive operations.

The free surface of the peritoneum consists of a single layer of flat polygonal epithelial cells, filled with a fine granular protoplasm. These cells are held together by delicate fibrils, which, by their elasticity, allow the peritoneal layer to adapt itself continually to the changes in size of the hollow organs which it encompasses.

Between the epithelial cells are numerous small openings or stomata through which the lymph-vessels empty into the peritoneal cavity. Each small open-

[1] Chief authority, Fromme.

ing is surrounded by epithelial cells arranged in a somewhat concentric order, the power of contraction of which probably controls the size of the stoma.

Under the surface epithelium lies the subserosa, which consists of bundles of connective tissue, elastic fibers, and fat. In this tissue runs a rich network of communicating lymph-vessels, besides blood-vessels and nerves. The lymph-vessels of the peritoneal and pleural cavities communicate by perforating the diaphragm.

The nerves of the peritoneum lie in the subserous layer and are not particularly numerous. It has been shown that the parietal peritoneum is much more sensitive than that covering the viscera, due to the communication which its serosa has with the intercostal, lumbar, and sacral nerves. Between the muscular layers of the intestines there runs a rich network of sympathetic nerves, with many microscopic ganglia, the so-called "Auerbach's plexus," which plays a very important part in the intestinal paralysis of peritonitis, ileus, etc. Under normal conditions the production and absorption of fluid is so regulated that the peritoneal surface is kept sufficiently moist to provide for perfect lubrication for the movements of the various organs, but under pathologic conditions the power of the peritoneum, both for production of fluid and its absorption, is enormous.

The surface of the peritoneum is very great and is said to equal that of the outside of the body. This great extent of absorbing surface is of advantage in taking care of the products of mild infections, such as frequently ensue after operation, but is a source of danger when the infection spreads over a large part of the area, in which case so much toxic material is absorbed that the resisting power of the individual is overcome. To counteract the tendency of infections to spread over the entire abdominal cavity is the anatomic arrangement by which the cavity is divided into numerous sacs, which, though communicating with each other normally, are, when infected, readily isolated by adhesions. The isolation and exclusion of these various sacs or pockets of which the true pelvis is the most notable example is greatly facilitated by the great omentum and the movable portions of the colon, especially by the sigmoid flexure, less often by coils of the small intestine.

The omentum is of inestimable benefit in the walling off and localization of infection. On account of its length and mobility it is able ordinarily to reach any portion of the abdominal cavity, and in most cases of localized peritoneal infection the omentum will be found doing a large share of protective duty. Its adhesive power is enhanced by its endowment with four peritoneal layers—two on the outer surfaces and two toward the omental bursa. The omentum is, therefore, exceedingly well supplied with blood- and lymph-vessels, and can furnish a greater amount of serum and phagocytes than can the rest of the peritoneum. Thus it is an important protective organ against infection, as has been proved by experimentation, in which it has been shown that animals from whom the omentum has been radically removed are much less resistant to peritoneal infection than are normal control animals.

The omentum besides its protective power also has a corresponding absorbing power, greater than that of the rest of the peritoneal cavity. In addition to this, it has the astonishing ability to fasten itself to organs that have been bereft of their circulation, establish a new communication of blood-vessels, and thus nourish the organ or prevent its being infected. A good example of this is the way in which parasitic fibroids that become detached from the wall of the uterus are nourished and kept alive by the protecting care of the omentum.

The omentum is also of great use in surgical operations for the plastic covering up of defects in tissues, such as extensive denudations after the removal of adhesions. It has been shown by experimentation that when a piece of omentum is transplanted to a denuded surface a communication of blood-vessels between the two takes place on the second day.

The researches of Bloomhardt, Andrews, and Hetherington at the University of Pennsylvania Hospital have added much to our knowledge of the practical surgical usefulness of the omentum. They have shown by experiments on dogs that perforations of the intestines and stomach heal without peritonitis when simply covered by peritoneum. Rapid end-to-end suture of intestines without the Lembert seroserous stitch heals without leakage if the omentum be wrapped around the line of suture. After ligation of main mesenteric vessels gangrene of the corresponding area of gut does not take place if it be covered with omentum, stitched in place through the mesentery. A knowledge of properties of the omentum such as these is of inestimable value to surgeons.

Another very important service that the omentum performs is its capacity to slip into defects of the abdominal wall and thus prevent the entrance of the intestine. In most ventral hernias it is most effective in preventing involvement and injury of the bowel. In inguinal hernias the same is true whenever the omentum is long enough to reach the opening. In penetrating wounds of the peritoneum the omentum by its extraordinary mobility and lability often enters the wound first and prevents the prolapse of the intestine.

The peritoneum has a special protective characteristic in that it is not easily penetrated by external infection. Subperitoneal abscesses, such as occur in abdominal wounds or in the parametrium, do not often extend into the peritoneal cavity. This is partly due to the fact that it possesses a remarkable power of elasticity and offers little resistance to the pressure of the abscess. The peritoneum also has an unusual reparative power of its epithelium, denuded surfaces being rapidly covered by newly grown cells.

**Transudation and Resorption.**—As has been said, there exists between the contiguous peritoneal surfaces only a capillary layer of free fluid which is just enough to keep the surfaces well lubricated. This fluid is continually being renewed and absorbed by the subserous circulatory apparatus already described. When, however, there is any irritation of the peritoneum an increased amount of the fluid issues in the form of a serous exudate. The epithelial cells become swollen and cloudy. A fatty granular degeneration takes place in the protoplasm, and there follows in places *a destruction and denudation of the epithelium.*

After the partial destruction of the surface epithelium the same irritat-

ing influence also injures the walls of the underlying capillaries, thereby creating a greater permeability for the passage of the exudate and a chemical change in the constituents of the blood. Together with the exudate, there takes place an outward wandering of leukocytes by diapedis. Fibrin coagulation takes place in the exudate. The exudate probably has little bactericidal action, but its function is probably to dilute the injurious toxins of the irritant, and, still more important, to pour into the peritoneal cavity a rich supply of leukocytes.

Absorption of fluid material in the peritoneal cavity is carried out by the subserous blood and lymph capillaries. If the absorbed material is toxic, its influence then is met by the general resisting power of the body, which is sufficient to neutralize a moderate amount of absorption. If, however, the toxins absorbed are too great in amount or too virulent for the general resistance to withstand, the individual succumbs. The combat against bacterial infection is also carried on by the phagocytic power of the leukocytes contained in the exudate.

**Adhesions.**—From the standpoint of the gynecologist the most important reaction that takes place from peritoneal irritation from whatever cause is the formation of protective adhesions. Adhesions are the result primarily of *injury to and destruction of the epithelial layer* of two contiguous surfaces. When the serous surfaces are denuded the connective-tissue subserous layers become united by fine strands of fibrin into which stream wandering cells (fibroblasts), so that eventually a true connective-tissue union is created. Adhesions competent to withstand the pressure of fluid and prevent the spread of infection may form within a few hours. In the early stages adhesions are filmy and easily broken up by the hand, but as time goes on they become more organized and denser and gradually contract in the manner of scar tissue. The eventual character and fate of adhesions depends somewhat on the nature of the cause which originally produced them.

Thus, we see that whatever produces a destruction of the peritoneal epithelium causes also the formation of adhesions.

The surface epithelium of the peritoneum may be destroyed (1) by bacterial infection; (2) by chemical injury; (3) by mechanical insults, and (4) by surface necrosis due to local interference of the blood supply. These may, therefore, be regarded as the four chief causes of peritoneal adhesions.

(1) *Bacterial Peritonitis.*—From the standpoint of gynecology we are interested principally in those forms of peritonitis which are confined chiefly to the pelvis, and of these the most important is that which results from gonorrhea. Gonorrheal peritonitis ascends from a primary infection of the external genitals and extends through the tubes to the pelvic peritoneum. In the great majority of cases the inflammatory process is confined to the posterior half of the pelvis, and it is in this region, therefore, that we find the principal adhesions. The surface of the tubes and ovaries is the first to be affected, so that the earliest adhesions form between them and the posterior aspect of the broad ligament against which they naturally rest. If the disease progresses adhesions form,

uniting the posterior surfaces of the adnexa and uterus with the rectum and sigmoid or other portion of bowel that may have prolapsed into the true pelvis. The contraction of the adhesions draws the pelvic organs backward and downward deep into the posterior and lateral culdesacs. The disease is localized in the pelvis partly by gravity and partly by the protecting services of the great omentum and the sigmoid flexure, which, as a rule, prevent the infection from spreading above the brim of the pelvis. Adhesions from gonorrheal peritonitis have little tendency to become absorbed, but rather grow denser and tougher with time. They are also notable for their contractile power and result in serious displacements of organs.

Infection of the pelvic organs by puerperal sepsis results in fewer adhesions than does that from gonorrhea, and for that reason it is less likely to be confined to the pelvis, and much more frequently extends to the general abdominal cavity, causing a diffuse peritonitis and death. Such cases are usually due to the streptococcus, the virulence of which is so great that time is not given to the plastic apparatus of the peritoneum to form protective adhesions before a fatal dose of toxins is absorbed.

Other organisms than the streptococcus may infect the pelvic organs from puerperal sepsis, chief among these being the staphylococcus group.

A third common form of adhesions from bacterial peritonitis is that which is produced by tuberculosis, the invasion of which takes place either by continuation from a general abdominal peritonitis or through the blood-current from some distant focus, usually in the lungs or lymph-glands. The adhesions resulting from tuberculosis are often extremely dense and vascular, so that it may be impossible to separate them without causing serious damage to the organs which they involve. Tubercular adhesions, even the most resistant, have the peculiarity of often being completely absorbed, a characteristic which is not seen in adhesions due to gonorrhea.

(2) *Adhesions due to chemical injury* are comparatively uncommon. The irritation and adhesions from bile spilled in the peritoneal cavity is an example of this, as proved by the results of injecting sterile bile into the abdomens of animals. Another example is the adhesive peritoneal irritation seen in pesudomyxoma peritonei. Doubtless the adhesions from uninfected blood-clots in the pelvis, such as sometimes result from tubal abortion, have their origin in the chemical irritation of the disintegrating blood. An excellent example of chemical injury is the peritoneal adhesions, which occur after oil has been left in the abdomen under the mistaken idea that oil will *prevent* adhesions.

(3) *Adhesions due to mechanical injury* are the result of a mechanical destruction of the peritoneal epithelium, by which two damaged contiguous surfaces become united in the manner described above. As a pathologic lesion this is most commonly seen in some of the adhesions that form on large tumors, where the destruction of the peritoneal epithelium is due to pressure necrosis.

Traumatic adhesions resulting from injuries to the peritoneum during surgical operations are included in this group, though it is not always possible to

state whether certain postoperative adhesions result from trauma or from mild sepsis. There is no doubt that the leaving of raw surfaces or ragged wound edges is usually followed by adhesions. Clumsy protruding catgut knots may also be followed by the same result. Other traumatic causes of adhesions are rough handling of the intestines, improper use of dry gauze and abdominal retractors, too long exposure to the drying influence of the air, etc.

One of the most important matters in the consideration of traumatic adhesions is the artificial creation of them for the purpose of making new ligamentous supports for prolapsed organs. Here the knowledge of the physiologic process of adhesion formation is of great practical value to the surgeon, for without an appreciation of this process many of his reconstructive operations are sure to result in failure.

We know that the approximation of two epithelial surfaces will not result in adherence unless the surfaces are first denuded or destroyed. This is as true of the peritoneum as it is of the skin or of mucous membrane. If, therefore, it is desired to create a permanent ligamentous attachment between two peritoneal surfaces, one must be sure to destroy the epithelium of both surfaces over the area of desired adhesion. The contiguous serous surfaces may be denuded or scarified or destroyed by the pressure of a very tight knot.

The most common practical application of this principle is in performing the operation for ventral fixation or suspension. The old-fashioned method of doing this operation was to place several stitches through the posterior wall of the uterus and the abdominal wall, and to scarify or denude the opposing peritoneal surfaces. This resulted in an extensive adhesion, which bound the uterus so closely to the abdominal wall as to immobilize it completely and lead to serious danger in later childbirth. The so-called "ventrosuspension operation" was done by uniting the peritoneal surfaces by a light tie. A frequent result of this operation was a complete healing of the peritoneum without the formation of an adhesion, or the adhesion might be very slight, so that the drag of the uterus drew the abdominal peritoneum out into a long filament, causing danger of entangling the bowel in an obstruction.

The success of the Gilliam type of operation depends eventually on the adhesions which form between the round ligaments and the peritoneum at the point of penetration.

The success of Olshausen's operation is dependent on tying the suture attaching the round ligament to the abdominal wall so tightly that the peritoneal epithelium included in the knot will be destroyed. If the tie is too loosely made, as is done by the use of catgut or animal tendon, there is danger of not creating a permanent connective-tissue ligamentous adhesion.

(4) *Adhesions Due to Surface Necrosis.*—This form of adhesions is best illustrated by the adherence of tumors with twisted pedicles to the peritoneal surface of surrounding organs. In this case interference of the blood-supply to the serous surface of the tumor is caused by torsion of the pedicle, with conse-

quent destruction and necrosis of the endothelial cells. The same result may follow interference of the circulation of the peritoneum from any other cause.

The possibility of adhesion formation from transmigration of micro-organisms through the intestinal wall as a result of stasis is discussed in the section on Intestinal Adhesive Bands (*q. v.*).

## RELATIONSHIP OF GYNECOLOGY TO THE BONES AND JOINTS

Between the pelvic organs and diseases of the bones and joints there is from the gynecologic standpoint no frequent direct relationship, if we exclude the influence of deformed pelves on childbirth, a subject which does not come within the sphere of this book.

It seems to be well established that osteomalacia is to a certain extent dependent on abnormal ovarian secretion, as is shown by the marked improvement in the disease following the operation of castration. Fehling, who discovered the relationship of osteomalacia to the ovaries, noted that women with osteomalacia exhibit a fertility that is double the normal. This disease is also shown to be much more common in woman than in man.

The effect of the ovarian secretion in the development of the skeleton has already been described on page 51 in discussing the effect of early castration.

If enteroptosis and nephroptosis be included in gynecology, the causal relationship between these conditions and the body form is of immense importance, as is pointed out in the sections devoted to those subjects.

The gynecologist is continually being consulted by patients who refer their bodily pains to disturbances of their pelvic organs, whereas, in reality, they are due to some orthopedic affection. This is pre-eminently true of patients who suffer with backache. The backache resulting from sacro-iliac strain is sometimes very like that from retroflexion, both in character and position, and can with difficulty be differentiated from it. The same is true of muscular strains involving the sacral and lower lumbar region. Backache above the lower lumbar and sacral region is never pelvic in origin, yet the idea that uterine displacements cause all forms of backache is so prevalent that patients are very prone to ascribe pain at any segment of the spinal column to pelvic trouble. The same is true of patients with foot strain, whose chief symptoms are felt in the back or thighs. The gynecologist must, therefore, be continually on the lookout for these cases, and to avoid needless treatment and operations where the symtoms are in reality from some orthopedic origin.

The postoperative treatment of gynecologic patients often requires an appreciation of orthopedic principles, especially in providing proper abdominal supports. Patients with incorrect body-form require the "remodeling" of the orthopedist, especially after operations for ptosis and abdominal hernia.

## RELATIONSHIP OF GYNECOLOGY TO ACUTE INFECTIOUS DISEASES

Acute infectious diseases, outside of pregnancy and the puerperium, affect the genital system only occasionally. The most common complication following these diseases is an acute septic vaginitis, which may extend to the cervix and uterine mucosa. This occurs mostly in children and may follow typhoid, cholera, pneumonia, variola, measles, scarlatina, and influenza. The vaginitis is often very severe, and may terminate in gangrene and sloughing of the entire canal. These severe inflammations may result in plastic adhesions of the vaginal surfaces, causing a partial or complete atresia. The vaginitis and plastic union of the walls may take place without attracting attention to the local disease, so that nothing may be known of its existence until delayed puberty with symptoms of obstructed menses make the condition evident. Many cases of atresia formerly thought to be congenital or the probable result of accidental gonorrheal infection are doubtless traceable to one of the acute infectious diseases contracted in childhood.

The cause of infection of the vagina is not always clear, as the specific organisms of the primary constitutional disease cannot usually be demonstrated in the vaginal secretions. It is probable that the resistance of the individual is so reduced that the vagina no longer exerts its normal bactericidal action, and the flora of the vulva find in the vagina a favorable seat for ascending infection. The organisms found in the vaginal discharge are usually of the streptococcus, staphylococcus, and colon bacillus varieties.

Occasionally, though not often, the tubes may be infected by the specific organisms of acute infectious disease, notably typhoid, pneumonia, and influenza. It is probable that the organisms in such cases reach the tubes through the circulation.

Disturbances of menstruation are very common during the attack of infectious disease, the irregularity consisting of too frequent and profuse flow. After typhoid there is apt to be a period of amenorrhea and atrophy for a few months.

During typhoid fever there may be a selective destruction of the primordial and Graafian follicles of the ovary, a process which may be so extensive as to result in the death of all the follicles, with consequent atrophy of the ovaries, amenorrhea, and sterility (Stolz). Whether this effect on the parenchyma of the ovary is the result of the typhoid bacillus circulating in the blood, or whether it is accomplished by a toxin, is not known.

Diphtheria may occur secondarily or primarily in the vagina. It produces ulceration and possible gangrenous sloughing, with ultimate atresia.

Influenza affects the genital organs in a considerable percentage of cases, chiefly in the way of causing irregular menses. Menstruation is often brought on at the beginning of the attack, even in individuals who have had long-standing amenorrhea. The menstrual disturbance may appear as a menorrhagia, but very frequently as a metrorrhagia. The uterus in these cases is found to be

large and boggy. It is characteristic that the metrorrhagia caused by influenza may last a long time after the influenza has disappeared and be exceedingly intractable.

Influenza may also cause certain acute infections of the pelvic organs, among which there have been described cases of salpingitis, parametritis, urethritis, and cystitis. Gonorrheal infections of the pelvic organs are often lighted up into new activity by an attack of influenza.

It has been shown also that pelvic tumors, such as cancers, uterine fibroids, and ovarian cystomata, sometimes undergo a rapid enlargement during an infection of influenza.

Malaria may also cause a metrorrhagia, and it has been observed that the metrorrhagia may share in the periodicity of the disease appearing at a certain time each day.

It may be said, in general, that as a consequence of any acute general infection there may ensue a period of amenorrhea, with atrophy of the ovaries, uterus, external genitals, and breasts. This, however, is usually a temporary manifestation unless there has been some specific destruction of the ovarian follicles, and disappears when the patient has regained her normal health and strength.

## ENTEROPTOSIS

Although there is no very definite relationship between diseases of the pelvic organs and enteroptosis, nevertheless the latter condition is so common in women and so often associated with asthenic relaxation of the genital apparatus that it comes almost constantly to the notice of the gynecologist.

Enteroptosis relates to a downward displacement of certain portions of the digestive tract owing to an inadequacy of the natural supports, while other portions remain fixed. In this way the intestine becomes kinked at the points of firmer attachment, with consequent partial obstruction to the normal flow of intestinal contents. The retardation of the intestinal function is termed "intestinal stasis," and results in certain characteristic digestive and constitutional symptoms.

The etiology of enteroptosis is at present believed to be referable primarily to congenital defects in certain attachments of the alimentary canal which are normally supplied by nature in man alone to support the abdominal organs on account of his erect posture. In addition to the primary cause of congenital deficiency of supporting attachments are other predisposing causes, namely, those resulting from inborn or acquired changes in the body-form of the individual, from the loss of subperitoneal fat, and from a deficiency in the muscular force of the abdominal musculature. The supporting attachments of the viscera with which man is endowed in contradistinction to quadrupeds represent the fusion of certain peritoneal surfaces that takes place during the prenatal development of the intestinal tract, and, as Coffey remarks, are undoubtedly

"for the purpose of holding the organs in their places, thus to prevent them from piling up in the bottom of the abdominal cavity by gravity."

To quote Coffey further:

"In studying the abdominal cavity from the standpoint of comparative anatomy we find that in man the liver has fused with the diaphragm, while in the quadruped it is suspended by a mesentery the same as other organs. In man the duodenum is firmly fixed to the right abdominal wall, while in the quadruped it is freely movable. In man the ascending colon and descending colon and the two flexures are normally fixed to the posterior abdominal wall without the intervention of mesentery, while in quadrupeds the large intestine has a long mesentery and is, therefore, freely movable. In man the great omentum grows down over the transverse colon and adheres to it. This does not occur in the quadruped. In man the omental bursa is usually obliterated by adhesions of its layers together. Obliteration does not take place in the quadruped.

"In man the pancreas has been rotated behind the peritoneum and fixed to the abdominal wall. In quadrupeds the pancreas lies between the layers of the mesentery.

"In the monkey, which is a quadruped with a tendency to stand erect, the pancreas becomes adherent, and the duodenum is more firmly fixed than in the original quadruped.

* * * * * * * * * * * * * * * * * * * * * * *

"The solid organs of the upper abdomen which are fixed in man and movable in the quadruped are the kidneys, liver, spleen, and the pancreas.

"The parts of the intestinal tube left movable in man are the middle part of the stomach, the transverse colon, and the small intestine down to a point near the ileocecal valve and the sigmoid colon.

"The transverse colon is attached by fusion to the posterior leaf of the omentum, which, in turn, is attached to the anterior leaf by the same process for the purpose of preventing the middle of the transverse colon from sagging and pulling on the two flexures."

With this excellent description of the anatomy of visceral support the pathology of ptosis can be easily understood.

The most common defect in the supporting attachment is represented by a lack of fusion of the cecum and ascending colon to the parietal peritoneum, so that this portion of the large intestine instead of being normally fixed is suspended by a mesentery as in quadrupeds. The ascending colon, therefore, with its great weight of feces and water, drags heavily on the fixed point at the hepatic flexure, produces a sharp kink in the canal, with consequent retardation of the flow of intestinal contents. If the fixation at the hepatic flexure is sufficiently strong to resist the drag of the colon and cecum, the cecum gradually becomes stretched out and dilated, often reposing deep in the true pelvis. This constitutes the so-called "cecum mobile" of Wilms.

There exists between the ascending and descending colons membranous attachments to the lower poles of the kidneys. Downward displacement of the ascending colon, therefore, exerts a drag on the right kidney and is thought by some to be the chief cause of renal prolapse.

Displacement of the descending colon is much less common than on the right, because of the more powerful attachment at the splenic flexure, which is the last point to give way in extreme cases of visceroptosis. In this way the infrequency of prolapse of the left kidney is accounted for.

Ptosis of the transverse colon may take place entirely independently of the ascending colon, and is termed "mid-line ptosis" by Coffey, who advances the following theory for its occurrence.

Between the hepatic and splenic attachments the colon has no parietal support. Nature has attempted to make up for this by fusion of the inner surfaces of the leaves of the omental bursa. As a result of this fusion the gastrocolic omentum is formed, which acts to suspend the colon from the lower border of the stomach. If the omental bursa fails to fuse this support is wanting, and the transverse colon is susceptible to prolapse as a result. Ptosis of the transverse colon causes sharp kinking of the two flexures, especially at its splenic attachment, with consequent tendency to severe constipation.

Prolapse of the stomach represents also a mid-line ptosis, the displacement occurring between the firm esophageal attachment on the left side and the attachment situated at the second portion of the duodenum on the right. In this form of prolapse a kink is established at the point of duodenal attachment, with consequent distention of the duodenum, pylorus, and stomach.

According to Coffey, Goldthwait, and others, in practically all cases of enteroptosis can be demonstrated anatomic defects of embryologic fusion and abnormal mobility of the intestine.

Of the predisposing causes for ptosis the most important are congenital or acquired errors in body form, and it may be said that in a normally formed body, which during life is maintained in correct posture, even if there be congenital defect in rotation and fusion of the intestine, ptosis probably does not take place.

When a normal individual stands in the proper erect position the upper part of the abdomen in which the heavy organs lie is expanded by the widening of the ribs and the raising of the diaphragm, while the lower abdomen is compressed and flattened by the firm contraction of the abdominal muscles. If a sagittal section be made through the body in this position, it will be found that the outline of the abdominal cavity is shaped like a pear, with the large end uppermost and inclined backward at an angle of 51 degrees (Coffey) (Fig. 25). The lower curve of the pear-shaped contour corresponds to an inclined shelf formed by the psoas muscle and a firm retroperitoneal pad of fat (Fig. 25). This padded shelf helps very efficiently to sustain the weight of all the heavy organs of the upper abdomen, excepting the pyloric end of the stomach and the transverse colon, which lie *in front of the shelf* and which, as has been shown, depend for their support on their rather meager suspensory ligaments.

If, therefore, structural abnormalities of the body, either congenital or acquired, change the inclination of the padded shelf, making it *steeper*, the heavy organs lose their most important support and tend to slide downward, unless their attachments to the parietes are sufficiently firm to counteract the influence of gravity and abdominal pressure. This is the fundamental prin-

ciple which underlies the orthopedic treatment of visceroptosis, which, as we shall see, plays a most important rôle in the management of these cases.

Goldthwait, R. C. Smith, Swaim, and others have rightly divided enteroptotic patients into two types, the acquired and congenital, with reference to changes in bodily structure. The condition may be acquired by faulty posture in childhood, early lack of nourishment, habitual constipation, long-continued errors of posture from occupational exigencies, neglect of muscular exercise,

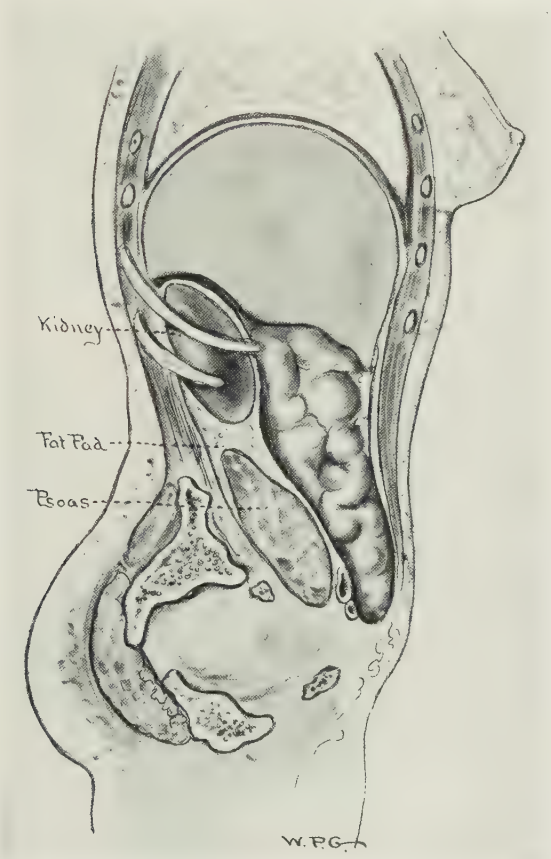


FIG. 25.—SECTION OF A NORMAL ABDOMINAL CAVITY SHOWING THE PEAR-SHAPED CONTOUR AND THE INCLINATION BACKWARD OF 51 DEGREES.

Note the position of the kidney under the last two ribs, and the supporting shelf of fat and muscle.

relaxation due to child-bearing, the loss of bodily fat, etc. The victim of acquired ptosis exhibits a general drooping of the body. The shoulders drag forward and downward, lowering and compressing the chest wall. The contraction of the ribs diminishes the upper area of the abdominal cavity, which, as we have seen, should be large and roomy. Compensatory changes in the bony framework alter the inclination of the pelvis, with consequent strain on the muscles of the back and the articulation of the sacro-iliac joints. The muscles of the abdomen

are relaxed and allow the abdominal contents to sag downward and forward. These structural changes cause an alteration in the contour of the abdominal cavity, as shown in Fig. 26. The outline, formerly represented by a pear inclined backward at an angle of 51 degrees, assumes a new shape. The outline of the upper part becomes contracted and the lower part enlarged, the whole assuming more of an oval shape, while the long axis, losing its inclination, approaches the perpendicular. In this way the protecting shelf formed by the psoas muscle and the overlying pad of fat is partially obliterated, thus allowing the downward drag of gravity on the heavy organs of the upper abdomen.

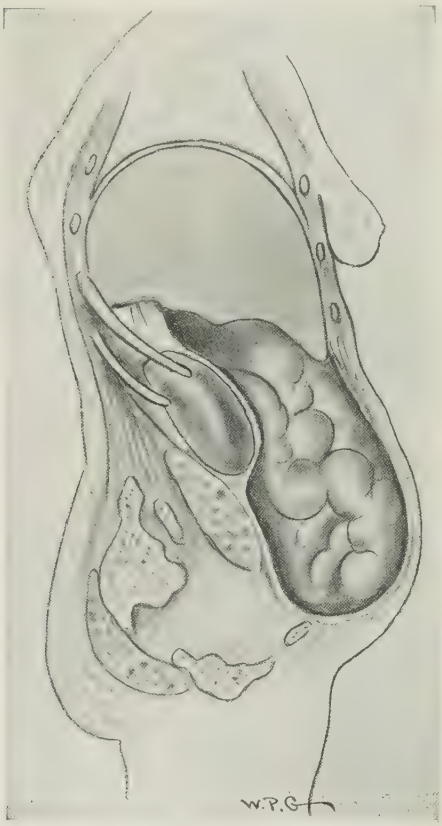

FIG. 26.—ENTEROPTOSIS WITH CHANGES IN THE BODY CONTOUR.

The congenital type of the enteroptotic is much more common than the acquired. In fact, it is probable that even in most cases of acquired ptosis physical errors in bodily structure of a congenital nature can be traced.

The following description, quoted from Swaim, pictures this type:

"As children they began life 'frail'; they could not attend school regularly; they grew up delicate of stomach, nervous, subject to attacks of indigestion, incapable of doing all the things they wished to do or that were expected of them. They seldom had had serious illness; sooner or later an inflamed appendix has been removed or the pelvic organs 'hitched up' because of menstrual disorders. At work they were clever, but incapable of sustained efforts without the inevitable results. Most of the patients beyond the age of twenty-one had had one or two nervous breakdowns. The physical characteristics in such cases are almost typical. Their standing posture is very bad; their shoulders are stooped; scapulæ prominent; the sacral and lumbar curves exaggerated; the abdomen prominent, especially in its lower half and with the chest flat; the muscles of the abdomen are lax; the erector spinæ muscles are thin and tense, accounting largely for the ache between the shoulders and the tired feeling at the base of the skull. The circulation is sluggish, the hands and feet are habitually cold and clammy, and especially so when the patient is under nervous strain. The blood shows secondary anemia, and in this type the blood-pressure is usually subnormal while the temperature is always subnormal in the morning. Examination of the abdomen generally shows it to be of the scaphoid variety with a very acute sternocostal angle. The ribs are long and reach nearly to the crest of the ileum. There is often some tenderness with spasm in the epigastrium or a little to the right of it. The cecal region is tympanitic and the 'corded sigmoid' is usually present. Pressure over the epigastrium causes a characteristic feeling of nausea and distress similar to the habitual discomfort experienced by the patients. Their loins are thin and the right kidney is either palpable or actually movable. Not seldom the edge of the liver can be felt and the aorta is pal-

pable in its whole length. With the patient on his face there is a distinct hollowing in the costo-vertebral angle, showing an absence of retroperitoneal fat. About 10 per cent. of such cases have slight lateral curvatures. The urine usually is normal. The gastric analysis may show normal findings, or hyperacidity or anacidity, and this varies from time to time. The stool shows, as a rule, considerable undigested material. The *x*-rays show the long, tubular 'drain-trap' stomach, some stasis with lack of peristalsis. The small intestines are rarely visible because of hypermotility, as demonstrated by the early filling of the cecum. In this type the small intestines have a tendency to be short. The radiograms of the colon show stasis at the cecum or at the transverse sag. It seems probable that a mechanical obstruction of the bowel takes place, producing malnutrition, which, in turn, makes the position of the intestines more potent. Veils and bands are, of course, to be found. Let us study the patient more closely. Normally, abdominal fat covers all the abdominal organs and nerve plexuses. Where the abdominal fat is lacking they are exposed. It is generally believed that fat supports the kidneys, plus the more obvious supports.

"In these patients there is almost always a lack of fat tissue. The drag downward of the stomach and intestines must come on their attachments, especially the mesentery, which carries all the nerves and the blood-vessels of the small intestines and transverse colon."

In a very considerable percentage of cases of congenital enteroptosis there exists some pelvic abnormality with corresponding symptoms, and it is for this reason that the gynecologist shares an equal interest in the subject with the internist, general surgeon, and orthopedist.

As was stated above, there is no very definite causal relationship between enteroptosis and pelvic disease, excepting in cases where pelvic adhesions may cause a forcible dragging down or fixation of the intestines. The pelvic abnormality so frequently accompanying enteroptosis is to be regarded rather as an associated condition, and usually represents some form of genital hypoplasia. It is, of course, possible that early ill nourishment of the congenital ptotic may interfere with the full development at puberty of the genital organs, but this is probably not an important element, in view of the fact that a very large number of patients are seen with genital hypoplasia who are otherwise completely developed and without the slightest tendency to enteroptosis. In individuals who manifest a lack of development elsewhere it is to be expected that the generative system should share in the general physical deficiency, at least in a considerable percentage of cases, and this is true of the ptotic patient. The independence of development that the genitals often exhibit with reference to the rest of the body is not infrequently shown in the congenital enteroptotic by an entirely normal pelvic apparatus.

The abnormalities of the pelvis most often associated with enteroptosis are malpositions, usually either anteflexion with retrocession or retroflexion. Occasionally one encounters a procidentia in a nulliparous woman. Deficiency of ovarian function with amenorrhea or oligomenorrhea is frequent. Dysmenorrhea and sterility are extremely common.

The **symptomatology of enteroptosis** is a subject so extensive that it can be touched on only superficially here. The symptoms are due to the retardation in the bowel of the fecal contents, a condition aptly termed by Lane "intestinal stasis," and are evoked by the absorption into the circulation of toxic products

from the stagnating and decomposing material. The typical symptoms consist of frequent nausea and vomiting, often severe and sometimes accompanied with blood, loss of appetite, diminution in body weight, sometimes rapid, circulatory disturbances, such as coldness of hands and feet, constipation with much gas formation of the bowels and discomforting distention, mental apathy, and a great variety of muscular and joint pains. Many of the patients exhibit characteristic skin changes, especially acne and sallowness of the complexion. Nervous symptoms of all kinds and severity, amounting sometimes to mental derangement, are practically always present. Swaim has called attention to the possibility that much of the symptomatology may be referable to pressure and stimulation of nerves of the sympathetic ganglia, with consequent influence on the organs of internal secretion.

If pelvic abnormalities are present, and sometimes even when they are not demonstrable, there may be severe disturbances of menstruation, usually dysmenorrhea, and various forms of genital psychoneuroses.

As a result of the studies of Metchnikoff and Lane, many diseases are thought to be the direct resultant from the auto-intoxication of intestinal stasis, such as arteriosclerosis, nephritis, diabetes mellitus, rheumatism, various arthritides, ulcer of the stomach, cholelithiasis, cystic, and malignant degeneration of the breast, etc. Undoubtedly, the lowering of general resistance caused by enteroptosis makes the individual more susceptible to these diseases, even if the relationship is not more direct. Metchnikoff has succeeded in producing calcareous deposits in the arterial walls of animals in whom an artificial intestinal stasis has been created.

The diagnosis of enteroptosis and stasis, though frequently obvious, is in all cases ultimately made by *x*-ray pictures of the intestine, the details and significance of which should be interpreted only by an expert röntgenologist.

The **treatment of enteroptosis** calls for the coöperation of more specialties than almost any other disease, and may require medical, orthopedic, surgical, gynecologic, and neurologic measures.

*Medical* treatment is necessary in all cases, and consists primarily in prescribing a simple digestible diet and a proper course of hygiene. At first the lubrication of the intestine must be gained, and for this the better preparations of liquid paraffin (Russian oil) are at present in the greatest favor. Hydrotherapy when available is unquestionably of much benefit.

*Orthopedic* treatment is in all cases of the greatest importance, even when drastic surgical measures are undertaken. It consists in the application of braces and supports which correct the posture and support the prolapsed viscera. In addition, the patient is taught to assume various positions which relieve the drag of the viscera and to perform numerous exercises to strengthen the weakened muscles of the trunk. The problem of the orthopedic treatment has been worked out pre-eminently by Goldthwait, to whose writings the reader is especially referred. Inasmuch as the body form is faulty in all cases of

enteroptosis, orthopedic treatment must supplement all other measures. This is not sufficiently recognized in the cases which are treated surgically. Goldthwait has emphasized this point in the following (slightly modified) quotation:

"Special attention may be given to a particular organ, but the importance of the influence of the other organs or other structures upon the special organ must not be lost sight of. Operations may be performed, but before it is attempted to sew a stomach in what is supposed to be its normal position, it must be seen that the body is so remodeled that the proper amount of subdiaphragmatic space exists for the organs. A hole must be prepared before a peg can be put into it. To suture a stomach or liver to the upper abdominal region, when the ribs and diaphragm are so low that when the body is used they continually crowd the attached organs downward, must frequently result in greater discomfort than existed before. A movable organ under such conditions is better than a fixed one, because it may have periods of ease or acquire new positions in which reasonable function is possible. In the fixed position this mechanical interference may be constant. When such operations are required, if the body is considered with reference to all its parts and the mechanistic significance of the relationship of the many organs each to the other is kept in constant memory, care must be taken to see that the body is prepared by a period of remodeling, or special exercises are given, or postures assumed, so that the organ when put in place can have the best chance to do its work."

The *surgical* treatment of enteroptosis is also too broad a subject to be treated here more than superficially, and is at the the same time in such an experimental stage that definite conclusions are as yet unjustifiable. In speaking of the surgery of enteroptosis it is to be noted that we do not include operations for the frequently associated membranous adhesions, a subject which is dealt with later (see page 178).

Some of the operations that have been employed with greater or less success are as follows. Rovsing, a pioneer in this branch of surgery, has sutured the stomach wall directly to the peritoneum of the anterior abdomen, and has from time to time reported astonishingly good results. His method, however, has not been generally adopted.

Beyea shortened the gastrohepatic ligament, but this method, though sounder in surgical principle than that of Rovsing, proved inadequate on account of the natural weakness of the ligament. Lane, to whom belongs the chief credit of demonstrating to the profession the possibilities of surgery in the treatment of ptosis, applied heroic measures by either removing the colon entire or short-circuiting it by cutting off the ileum and planting it in the lower bowel. These radical operations have been widely tried, but with rather disappointing results.

Wilms, recognizing the importance of the stretched-out movable cecum in the condition of stasis, fixed the cecum to the lateral parietal wall with considerable success.

Coffey, appreciating the principle of suspension without fixation, devised an operation which has proved very efficient. The steps of the operation are as follows: First, shortening by plication the falciform peritoneum, thus sustaining the liver; second, shortening the gastrohepatic omentum by plication (Beyea's method), thus giving a greater support to the stomach; third, suturing the

greater omentum along a line just below the transverse colon to the parietal peritoneum, thus affording a strong support both for the colon and indirectly the stomach. In addition to the operations of suspending the viscera, an attempt is made to restore the contour of the abdominal cavity by enlarging the space of the upper abdomen and compressing that of the lower abdomen. This is accomplished by splitting the anterior sheaths of each rectus muscle and by leaving unsutured the wound of the aponeurosis made by the original incision. The pendulous lower abdomen is strengthened by a special plastic operation of overlapping the aponeurosis. Coffey's operation, on account of its simplicity and logicalness, has been very extensively employed, with varying results.

In giving a general estimate of the surgery of enteroptosis in the light of present experience it may be said that notwithstanding the numerous failures that have been recorded against it, the brilliant results of Lane, Coffey, and others have demonstrated that certain cases of enteroptosis are surgical and that failures are often due to lack of judgment in selection of cases, inadequate experience in performing the operations, and, above all, to inappreciation of the orthopedic requirements of practically all cases.

As to the various operations that have been employed it may be said that the complete resection of the colon is, in our present state of knowledge and experience, too radical a procedure, excepting in extreme cases, though in the light of the continued verification of Metchnikoff's theories one cannot help believing that at some future period the operation may become one of immense benefit to the human race. Short-circuiting of the colon is also looked on with disfavor by many surgeons, who have tried it enthusiastically, only to be disappointed in its results. In certain cases, however, there is no doubt of its value. The conservative operation of Coffey is also at the time of writing looked upon unfavorably by numerous surgeons, who have not found in it the universal panacea that they had anticipated. We have personally found it extremely useful, and ascribed the failures that we have met with to inexperience in the technic and to a neglect of the orthopedic requirements.

The *gynecologic* treatment of enteroptotic patients is the same as that of pelvic disease under other conditions. It must, however, be borne in mind by the surgeon and explained to the patient that surgical treatment of the pelvic organs is directed toward the local symptoms only, and that relief of them does not involve a disappearance of the train of symptoms caused by stasis of the intestines. For this reason it is of the greatest importance that the gynecologist should be familiar with the pathology and clinical picture of enteroptosis. Fortunately the idea is passing—though it has not yet entirely passed—that all kinds of digestive disturbances, muscular pains, and nervous derangements may be "reflexes" resulting from a misplaced uterus or cystic ovary.

If the pelvic organs are giving the enteroptotic definite symptoms for which a pelvic operation offers a reasonable hope of relief, the operation is indicated. If the ptotic condition is also one for surgery, the two operations may be done

at the same time, with proper regard also for the necessity of orthopedic remodeling of the faulty body structure.

Of much importance in the performance of the pelvic operation is a consideration of the abdominal wall, which in most cases is in a state of relaxation. The operation recommended by the author (see page 821) may be used with much advantage to strengthen the wall and compress the lower part of the abdominal cavity. It is of especial value in cases of acquired ptosis where there is usually a diastasis of the recti muscles.

*Neurologic* treatment of the enteroptotic is less prominent than it was before the clinical significance of the condition was generally recognized, and when these patients were regarded as hopeless neurasthenics.

In some cases, however, modern neurologic treatment is of prime importance in securing a complete recovery. These are the cases in whom the neurotic habits of introspection and overvaluation of symptoms have become so established that they do not entirely disappear after relief of the physical disability. These habit-neuroses are best treated by the methods of reasoning and suggestion with which the expert neurologists of today are acquiring such brilliant results.

## MOVABLE KIDNEY

The term "movable kidney" is a general one, relating to conditions of abnormal mobility of the kidney. Nephroptosis means falling or prolapse of the kidney, and is practically synonymous with movable kidney. Floating kidney, when properly used, relates to the more extreme cases of movable kidneys such as when the organ becomes completely invested by a covering of peritoneum and hangs loose in the abdominal cavity, or when it descends to the pelvis, or when it lies close to the anterior abdominal wall. Under these conditions the stretched out supporting tissues constitute a sort of mesentery from which the kidney swings.

Movable kidney is so common in women that it is included in the category of gynecologic diseases. Formerly supposed to be rare, it is now under improved methods of diagnosis estimated to occur in one out of every five women, in contrast to men, in whom the occurrence is only 2 per cent. In the vast majority of cases only the right kidney is affected. In a comparatively small percentage both kidneys are involved, while prolapse of the left kidney alone is extremely rare.

Kelly's figures show that symptoms of movable kidney appear most frequently between the ages of twenty and thirty, and that the condition is very rare in the young. Kelly thinks that the development of symptoms so frequently seen during the third decade may possibly be due to the fact that this is usually the most active period of a woman's life as regards bodily effort and child-bearing.

The **etiology** of movable kidney has been a subject of much theory and

speculation. In by far the great majority of cases the condition is acquired, a congenital origin having been established in only a few cases. Of the predisposing causes some, which, in the earlier studies of the disease were regarded as important, may be excluded as having little or at least only secondary influence. Of these may be mentioned tight lacing. The corsets in vogue at one period, which constricted the upper portion of the abdomen and a part of the chest wall, may have acted in conjunction with more fundamental influences in forcing the kidney downward. Pregnancy and labor, once thought to be a frequent primary factor, probably act only secondarily in relaxing the lower abdominal wall, thus favoring a tendency to visceroptosis in which the kidney may have a share. The frequency with which movable kidney is found in the nulliparous and the old-maid type is evidence that pregnancy is not to be regarded as of primary importance.

Traumatism in the form of sudden falls and jars, once regarded as a frequent cause of acute prolapse of the kidney, can probably be excluded. As in cases of retroversion and prolapse of the uterus, or other forms of relaxed tissues, the pathologic condition is the result of gradual stretching, either from constant strain or often-repeated traumatism. Congestion of the kidney, associated with menstruation or pregnancy or malposition of the uterus, is of very minor significance as an etiologic factor in nephroptosis, though it may often act to exaggerate the symptoms if such a condition already exists.

The fundamental etiology of movable kidney in the light of present knowledge is probably contained in the following conditions: (1) Physiologic deficiency of supporting structures; (2) errors in bodily structure; (3) drag on the kidney of the cecum and ascending colon; (4) loss of supporting fat.

In most cases of relaxed organs it is self-evident that there exists in the individual some inborn deficiency in the supporting tissue structure, rendering it unable to resist adequately the ordinary exigencies of physical life. This tissue deficiency may be general, as in cases of general visceroptosis, or localized, as in the case of a movable kidney or a retroverted uterus that exists in an individual otherwise perfectly sound.

Of chief importance in the etiology of movable kidney is the body form, to which it bears the same relationship as does enteroptosis. As has been shown in the discussion of enteroptosis, the heavy organs of the abdomen, including the kidneys, are contained in the upper portion of the abdominal cavity, the contour of which in the normal individual is shaped like a pear, inclining backward at an angle of 51 degrees. This inclination provides a sort of shelf which, with the aid of abdominal pressure and the padding of postperitoneal fat, supports all the heavy organs excepting the transverse colon and the pyloric half of the stomach. On this padded shelf the kidney is especially dependent for its support. The inclination of the shelf, and consequently its supporting power, is altered by changes in the body form caused by relaxation and drooping. The upper roomy portion becomes constricted by collapse of the chest wall

and the contents are forced downward. The lower abdomen becomes larger, the long axis of the cavity more vertical, and the pear-shaped outline of the abdominal cavity more cylindric. Hence the frequency with which nephroptosis is found in individuals who, either by inheritance or by improper posture, or by occupational requirements or other cause, are bodily malformed.

There is an undoubted influence between movable kidney and movable cecum. During the process of rotation of the intestine during embryonal life and its adaptation to the erect posture of man, the ascending colon, as has been stated on page 159, becomes fused with the posterior parietal wall and the anterior aspect of the kidney. It has been shown by anatomists that in 20 per cent. of subjects coming to the autopsy table there has been an incomplete fusion of the lower part of the ascending colon, so that instead of being supported by an attachment to the parietal wall it swings free on a mesentery, constituting the so-called *cecum mobile* of Wilms. The weight of the cecum, therefore, bears heavily on its attachment to the kidney, which, if its natural supports are congenitally inadequate, or if the angle of the padded shelf is lessened by incorrect body form, is dragged from its bed. Longyear, who has written a book on the subject, believes this to be the sole cause of movable kidney.

The presence of fat in the shelf on which the kidney rests is of considerable importance. The shelf, as has been seen, is composed of the psoas muscle and a pad of fat. If this pad of fat is lost by absorption, the shelf loses its supporting angle. Just how far this acts as a primary cause is problematic. Kelly has shown in his statistics that the rapid absorption of bodily fat is by no means constantly followed by nephroptosis, while on the other hand a very considerable number of his cases were either fat or moderately well nourished. It is not unlikely that the absence of the supporting fat pad, often noted in connection with movable kidney, is due to pressure which, as is well known, is a potent factor in causing the rapid disappearance of fat.

**Symptoms.**—In the great majority of cases movable kidney causes no symptoms whatever, and, considering the very great frequency of the condition, only exceptionally requires treatment. As is the case with the relaxation of other organs, the severity of the symptoms does not correspond to the degree of prolapse, some of the most troublesome symptoms occurring with only slight descent of the kidney.

Of the symptoms which make treatment of nephroptosis necessary is localized pain in the kidney region. This may be of a constant dull dragging character, or it may consist of sharp attacks resembling renal colic, sometimes attended with vomiting and prostration.

The dull dragging pain is felt in the back, the loin, and in the region in front of the kidney. It is sometimes associated with a sensation of something being loose in the right abdomen. It is frequently exaggerated by menstruation, and is always worse during pregnancy. The pain can be reproduced in character by filling and slightly distending the kidney pelvis with fluid. According to

Kelly, there is very little tendency of the pain to radiate downward, as in the case of pain from stone. Sharp attacks of pain are less common than the dull dragging variety. They represent sometimes the result of twisting or kinking the ureter with temporary hydronephrosis; sometimes a twisting of the renal pedicle without urinary obstruction. The attacks of pain when due to urinary obstruction may be followed by passing a large quantity of urine.

In many cases of nephroptosis there are marked gastro-intestinal disturbances. These take the form of gastric indigestion, severe constipation, mucous colitis, etc. These symptoms must not be regarded as "reflexes" resulting from descent of the kidney. They are probably, as a rule, manifestations of gastro-intestinal stasis from associated enteroptosis. The fact that such symptoms are sometimes cured by fixation of the kidney may be explained by the mechanical relief which the operation may afford to the drag on various parts of the intestinal tract which the prolapse of the kidney accentuated.

Patients with nephroptosis are frequently nervous, but the nervous manifestations are in no sense reflexes in the common acceptance of the term. They bear a causal relation to the kidney only when the nephroptosis is causing symptoms which by constant repetition irritate the nervous system. The effect on the nerves, therefore, follows the law emphatically laid down in the discussion of genital neuroses in the section devoted to Neurology.

Rare symptoms of movable kidney are jaundice and attacks of pain in the gall-bladder region, due probably to an obstruction of the gall-bladder from the drag which a movable kidney exerts on the duodenal attachment of the intestine to the posterior parietal wall. Besides these, other unusual symptoms are headaches, albuminuria, hematuria, irritation of the bladder, intercostal neuralgia, palpitation of the heart, edema of the legs.

Edebohls has demonstrated the frequency with which movable right kidney and appendicitis are associated. He ascribes the inflammation of the appendix to the effect of congestion of the appendical veins caused by the pressure of the kidney on the mesenteric veins against the head of the pancreas.

The **diagnosis** of movable kidney is a comparatively simple matter, but the decision as to whether in a given case the symptoms are due to the malposition of the kidney or to disturbance of some other organ may be very difficult. Diseases of the ureter, appendix, cecum, ascending colon, and the gall-bladder region must all be carefully excluded.

The anatomic position of the kidney can usually be determined by palpation. The patient is flat upon her back with the knees drawn up. The left hand is placed flat under the left flank, the ends of the fingers reaching the costovertebral angle of the last rib. This hand is held firmly, while the fingers of the right hand are pressed in front, just below the costal margin. The patient is requested to draw in a deep breath and then breathe out quickly. The movable kidney can be felt as a smooth body slipping between the fingers. A normally placed kidney cannot be felt except in very thin individuals.

The amount of descent is divided by Glénard into three degrees. By his classification the kidney is in the first degree of prolapse when the lower pole can just be felt on deep inspiration; it is in the second degree when the body of the kidney can be caught and held near its center and prevented from receding when the patient breathes out; it is in the third degree when on deep inspiration the entire kidney can be grasped and prevented from receding on expiration by holding the anterior and posterior walls together above the prolapsed organ.

In doubtful cases the pelvis of the kidney may be injected through a cystoscope and ureteral catheter. By this means the capacity of the kidney pelvis is tested and the presence or absence of hydronephrosis noted. The average capacity of the pelvis is 5 to 10 or 12 cm. Kelly estimates that in 1 out of every 7 cases of nephroptosis that give symptoms there is a beginning hydronephrosis.

The plan of injecting the pelvis has been shown by Kelly to be of advantage in determining the diagnosis, in that when the pelvis is filled to distention the pain, which the patient has been suffering as a result of prolapse of the kidney, is exactly reproduced.

If the pelves of both kidneys are filled with a metal salt, like collargol, an *x*-ray picture can be taken with the patient standing, from which very important information can be gained as to the comparative size and position of the kidney. This method of examining the pelvis of the kidney is termed "pyelography," and is very extensively used in diagnosis. The method, however, is not without danger. Buerger has recently reported cases in which both collargol and argyrol, used for the purposes of pyelography, penetrated into the renal parenchyma as far as the surface of the kidney and produced areas of necrosis and suppuration.

**Treatment of movable kidney** is to be employed only when the displacement is causing definite symptoms. When there are no symptoms present it is important to avoid informing the patient that she has a movable kidney, for knowledge of this kind in nervous women may create psychoneuroses and fixed ideas that become seriously troublesome.

When a movable kidney is giving symptoms it may be treated by either orthopedic or surgical measures, or by both.

Orthopedic measures consist primarily in correcting and remodeling the body when errors in structure are present. This is done by braces, postural and muscular exercises, as described in the section on Enteroptosis. In addition to this, the application of a properly fitting abdominal support, sometimes supplied with a pad, is most efficient in relieving and often entirely curing the symptoms of movable kidney. Whether in such cases an anatomic cure of the position of the kidney is completely secured is doubtful, but this is not necessary if the patient is relieved of her pain and discomfort.

Operative measures seek to attach the loose kidney to the muscles which lie behind it, so that it is prevented from descending. The operation when

properly performed and applied to the right case is usually successful. Many operations have been devised for the condition, one of which is described in detail on page 850.

## INTESTINAL BANDS

The subject of intra-abdominal bands is closely allied to that of enteroptosis, in that the two conditions are quite constantly associated. Nevertheless, they may appear independently of each other, and for that reason it seems best to treat the subjects separately.

Science is at the present time in a quandary as to the true etiology of these membranous bands, but the discovery of their existence and recognition of their clinical significance constitute an important step in medical progress. Numerous types of these structures have been described, and to them have been given picturesque names, a familiarity with which is necessary for the understanding of the literature on the subject. Some of the descriptions relate to bands that are found in the fetus, while others represent structures encountered during adult life.

(1) *The Bloodless Fold of Treves.*—This is a prenatal fold of peritoneum covering the head of the cecum and appendix, and, according to Eastman, found in more than 20 per cent. of fetuses. Eastman's description of this fold as he finds it is as follows:

> "It passes from the lateral posterior peritoneum to the terminal part of the ileum and the caput coli, fusing with the peritoneum covering the intestine. It is always more or less fan shaped, the broad attachment being to the mural peritoneum. The intestinal end is always the more narrow. It forms a pocket in which the vermiform appendix and more or less of the caput coli and cecum are ensconced."

Every surgeon will recognize having met with apparently non-inflammatory folds similar to this during the removal of the appendix, and having called the condition one of "retroperitoneal appendix."

(2) *The Parietocolic Fold of Jonnesco and Juvara.*—This is another membranous fold discovered in the study of fetuses. In the majority of the cases the fetal fold arises from the peritoneum at the left or inner side of the ascending colon, passing over the anterior aspect of the ascending colon in an upward slanting direction. It is attached to the parietal peritoneum at the right of the ascending colon. It may adhere to the anterior and lateral aspects of the colon (Bainbridge).

The similarity between this fetal structure and Jackson's membrane is to be noted.

(3) *Jackson's membrane* is a peritoneal fold frequently observed during abdominal operations and described by Jackson, who considered it the result of an inflammatory process. His description of the structure is as follows:

> "From a point just at the hepatic flexure to three inches above the caput coli there spreads from the parietal margin over the external lateral margin to the internal longitudinal muscle

band a thin vascular veil in which long straight unbranching blood-vessels course, most of which are parallel with each other, and take a slightly spiral direction over the colon from the upper peritoneal attachment to the inner lower portion of the gut, ending just above the caput. The appendix is not implicated in any way. Coursing with the blood-vessels are numbers of shining narrow bands of connective tissue, which gradually broaden as they go and end in a slight fan-shaped attachment at various points on the anterior and inner surfaces of the colon. At these points of attachment the gut is held in rigid plication. At the beginning of the hepatic flexure the drawn membrane particularly angulates the contained colon."

(4) *The Genitomesenteric Fold of Douglas Reid.*—This is a fold of peritoneum frequently found in the fetus, which extends from the mesentery of the terminal segment of the ileum down into the pelvis, being attached in the fetus to the genital gland below. It has also been termed by other observers the "appendiculo-ovarian ligament" (see page 147). It is occasionally seen during abdominal operations, and, aside from its possible connection with Lane's kink, sometimes is of clinical interest by causing a retroversion of the uterus. Reid ascribes to this connection between the appendix and adnexal regions the frequent association of inflammatory processes between the two. We have looked for the persistence of this fold in the course of abdominal operations extending over about twelve years and have occasionally observed it. Eastman has found it in a very considerable percentage of cases in fetuses after the seventh month and has also observed it in the adult.

(5) *Attic Adhesions.*—Adhesions about the gall-bladder and pyloric region are found with very great frequency, as any surgeon who makes a routine practice of examining this part of the peritoneal cavity during pelvic or other abdominal operations can testify. Morris has given the name of "attic adhesions" to these structures.

*Lane's kink*, or *ileopelvic band*, relates to a membranous attachment passing from the ileum to the parietal wall at a point near the ileocecal junction, frequently causing a sharp angulation. This is a structure noted in the adult. Eastman calls attention to its similarity to the genitomesenteric fold of Douglas Reid, and suggests that it may be a persistence of this fetal membrane.

Numerous other bands are described in various parts of the abdominal cavity, involving the appendix, pancreas, liver, stomach, and descending colon.

The clinical significance of all these various intra-abdominal bands lies in their tendency to obstruct the alimentary canal and cause symptoms and conditions of stasis.

The theories advanced to explain their existence may be divided into three classes: (1) That which assigns a fetal origin to them; (2) that which explains them as a result of a postnatal inflammatory reaction; and (3) that which asserts that they represent a non-inflammatory reaction on the part of nature to resist the ptosis of the abdominal viscera resulting from man's erect posture.

Those who believe in the prenatal origin of these bands point to the close similarity that exists between certain well-defined fetal structures and the membranes discovered in adult life, as is seen, for example, in the resemblance of the

parietocolic fold of Jonnesco to Jackson's membrane. The origin of the fetal membranes has not been satisfactorily explained, but it is known that at an

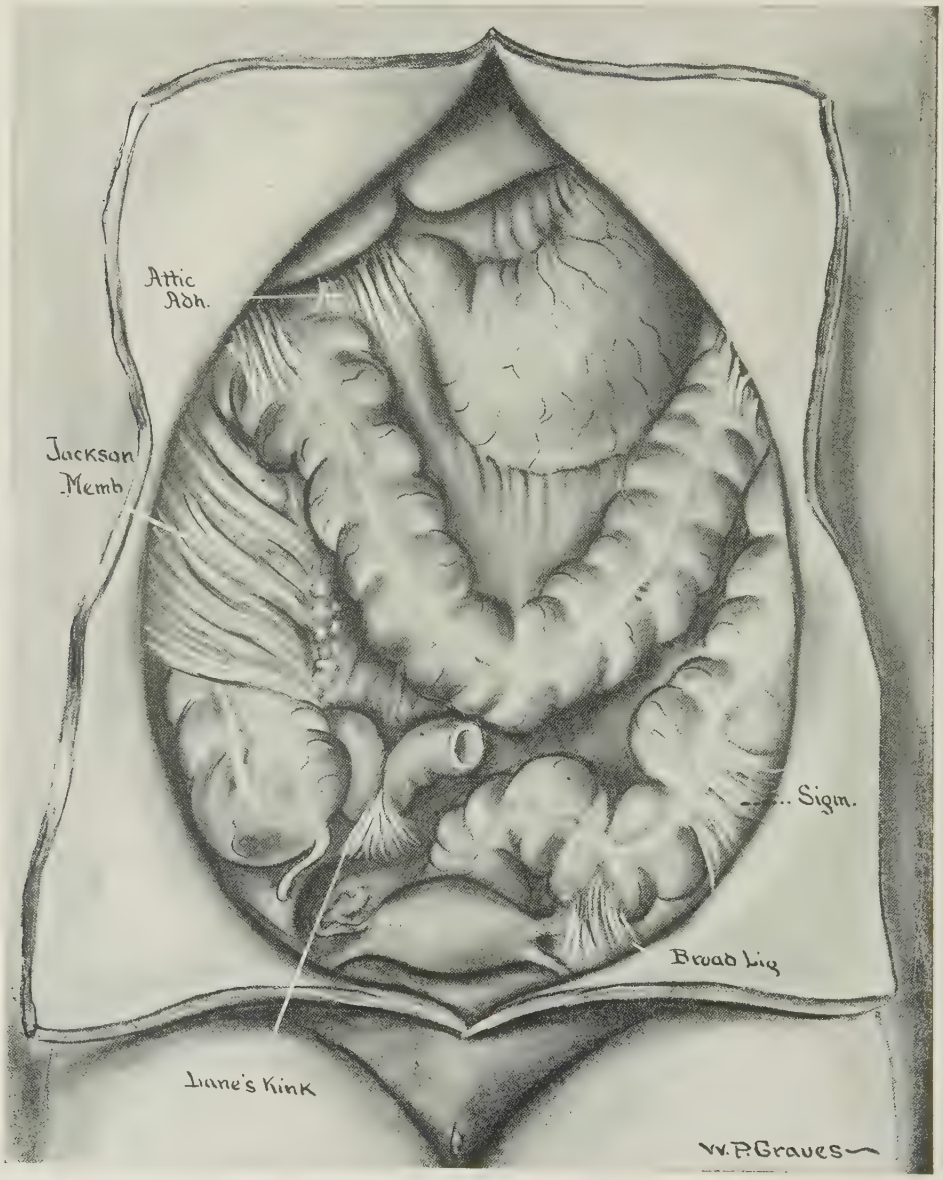


Fig. 27.—Abdominal Bands.

The drawing shows Lane's kink, Jackson's membrane, adhesions of the hepatic flexure, adhesions about the gall-bladder and pylorus, adhesions of the splenic and sigmoid flexures, and adhesions of the sigmoid to the left broad ligament. The small intestine and omentum have been omitted from the drawing for the sake of illustration.

early stage of fetal life the entire abdomen is filled with bands similar to those seen after an attack of peritonitis, and that toward the close of fetal life they

usually melt away (Bainbridge, Keith). It is urged by the supporters of the congenital theory of intra-abdominal bands that these bands represent the persistence after birth of certain of the fetal adhesions above described.

The adherents of the inflammatory theory of the origin of intra-abdominal bands base their assumption on an inflammatory reaction of the peritoneum covering the bowel induced by mild chronic infections of the mucosa, from which the process is transmitted through the wall (Pitcher, Gerster). Others (notably Martin) ascribe the adhesions to a traumatic reaction of the peritoneum resulting from overriding of comparatively fixed portions of the gut by abnormally movable viscera. Jackson regarded the membrane which he described as the outcome of a chronic pericolitis. Coffey is also an exponent of the inflammation theory.

The third theory, which assumes that the intra-abdominal bands represent an evolutionary provision of nature to resist the tendency of the viscera to prolapse, belongs peculiarly to Lane. He maintains that the efforts of nature to counteract the drag of the bowel results in a hypertrophy of its membranous supports, constituting, as Bainbridge well puts it, a "physiologic response to a mechanical demand." The bands or folds resulting from this process are termed by Lane "crystallizations of resistance" or "crystallizations of force." They are designed, first, in their physiologic rôle to facilitate the drainage of the bowel. Later they may come to defeat the very object for which they were created, and become material factors in obstruction and stasis. The points where these bands may form are described by Lane as follows: (1) In the third part of the duodenum and at the commencement of the jejunum; (2) at different points along the terminal coil of the ileum; (3) in the ileocecal region, including the appendix; (4) in the region of the hepatic flexure and the first part of the transverse colon; (5) at the splenic flexure; (6) at the sigmoid loop; (7) in the rectum.

No one of the causes which serve as a basis for the three preceding theories can explain satisfactorily all of the intra-abdominal bands, but it is probable that each one, either independently or in association with one or both of the other two, plays a part in the formation of a certain number of these structures.

**Symptoms.**—Intra-abdominal bands may cause no symptoms whatever, and they may act, as has been mentioned above, to prevent sagging of the bowel and maintain proper drainage. If, however, in association with enteroptosis they cause a retardation of the fecal contents the symptoms are those of stasis, as described in the section on Enteroptosis.

When intra-abdominal bands unassociated with enteroptosis constrict the bowel and cause symptoms, the clinical picture is somewhat different. Patients of this type may be well formed, often well-nourished in appearance. Symptoms of stasis may be in evidence, especially those of constipation, muscular pains, and lack of nervous equilibrium.

In these patients localized pain plays an important part in the symptomatology and may cause much difficulty in diagnosis. On the right side the affection may simulate adnexal disease, appendicitis, and affections of the kidney, or, if the pain is higher up, gall-bladder disease, ulceration of the duodenum or stomach. On the left side it may be confused with adnexal disease, with cancer, or diverticulitis of the sigmoid.

The **diagnosis** is made by excluding other diseases, but pre-eminently by the *x*-ray. In our experience the expert röntgenologist describes with astonishing accuracy conditions that are later verified by operation.

The **treatment** of constricting intra-abdominal bands that cause symptoms is essentially surgical. When enteroptosis is also present it should be treated according to the suggestions made in the section relating to that subject. The bands should be released by careful dissection. Many of these bands reach a marked degree of hypertrophy and constitute powerful structures. This is especially true of those which develop across the upper part of the ascending colon, by which the cecum and sometimes the duodenum may become very much distended. Not only must the main constricting bands be severed and dissected away, but frequently adhesions between loops of intestines must be released. If raw surfaces are created by this procedure, an effort should be made to cover them with peritoneum if any is available for this purpose. Sometimes it is advantageous to graft over the raw area a piece of fat removed from the omentum.

While performing an operation of this kind it is common to hear the remark that the operation is futile because the adhesions will re-form rapidly. This is a mistake, as we have on several occasions been able to testify when the abdomen had to be reopened for some other cause at a later date, the formerly adherent area being surprisingly clear of adhesions. If in cases of enteroptosis the release of constricting bands makes the condition of ptosis worse, provision for the support of the intestine can be made by attaching it to the parietes by the methods suggested by Coffey.

When intra-abdominal bands are encountered incidentally during the course of an abdominal operation they should be treated conservatively, for many times it will be found that they act as an efficient means of preventing ptosis. This is especially true of the veil-like forms of Jackson's membrane. If it is evident that the bands are constricting the bowel, they should be dissected.

PART II

# GYNECOLOGIC DISEASES

## Inflammations

### GONORRHEA

Considering its prevalence, the intractability of its local processes, and its far-reaching influence on the health and bodily resistance of the individual, gonorrhea in woman must be regarded as one of the most important of gynecologic diseases. Because of the greater complexity of the female genital tract the disease in woman is far more varied and more dangerous, both to life and health, than in man.

Gonorrhea has a unique standing among infectious diseases not only in its clinical manifestations, but in the fact that its specific organism, the gonococcus, has certain special characteristics that differentiate it conspicuously from all the pathogenic bacteria.

The microscopic appearance and the morphology of the gonococcus cannot be dealt with in this work; we are here chiefly interested in its clinical peculiarities.

There exists to the gonococcus no immunity whatever, either from previous attacks, or by individual resistance, or by hereditary racial qualities, such as belongs in some form to most other microbic organisms. In some married people there appears at times to be a mutual immunity to an existing gonorrhea, yet this is only apparent, for, under favorable circumstances, the infection may light up into activity in either of the pair, and is always capable of imparting an acute contagion when transferred to a third person.

The gonococcus finds its most congenial habitat on mucous surfaces, where it resides for the most part superficially between the interstices of the epithelial cells. It has little tendency to invade the lumina of deep-lying glands, such as those of the cervix and the vulva, but confines its activities to the glandular ducts. Nor does it have a disposition to penetrate into the subcutaneous connective tissue nor to invade the lymph- and blood-channels, although rarely it may do all of these things. Thus, it is sometimes found attacking the joints, or the tendons, or the valves of the heart, while a few cases of a general gonococcus septicemia have been reported.

The organism has a special predilection for certain human mucous surfaces, and when deposited on these grows immediately in the same manner as do other bacteria on their favorite culture-media. No abrasion or injury of the tissue surface is necessary, the normal uninjured epithelium being sufficient for its life and reproduction.

When confined in occluded spaces like that of a sactosalpinx, the gonococcus soon dies, whereas in unrestrained secretions it retains an extraordinary longevity and virulence.

The gonococcus is exclusively a human parasite. It is not found outside of the human body, nor can it readily be inoculated on other than human tissues. Moreover, it can be easily cultivated only on media made from human secretions. Thus, it will not grow on pure agar, but may be cultivated on agar combined with human blood. It will grow in hydrocele fluid, ascitic fluid, the contents of ovarian cystomata, and even in urine; but not in bouillon, animal blood-serum, and the other commonly used culture-media.

The gonococcus is extremely sensitive both to heat and cold, so that it must be grown at a definite temperature, a slight deviation from which one way or the other will destroy its growth. Even under the best circumstances the artificial cultivation of the gonococcus is difficult, for its growth is scanty and requires frequent recultivation. In the presence of other organisms in the culture it is readily crowded out. It is easily killed by most antiseptics, even those of mild bactericidal properties. On account of its tendency to invade the tissues on which it grows it is necessary to use such antiseptics as have the property of penetrating epithelial cells without damaging the normal tissue. Examples of this are the numerous silver preparations, iodin, permanganate of potassium, and methylene-blue. To these may be added mercurochrome, mercuriphen, and Dakin's solution (Norris). Antiseptics are more or less ineffectual in the presence of serum (Derby) and mucus (Norris). It is an important point to remember therefore in making local applications to remove first blood or mucus from the affected surfaces.

Another characteristic of the gonococcus is that it is infectious only in the moist state and that it grows only on moist surfaces. Under dry conditions it soon dies. Gonorrhea is, therefore, an almost purely contagious disease, and is rarely transferred indirectly except in the case of young children. With this last exception, gonorrhea of the genitals is transmitted almost exclusively by sexual contact. Acute gonorrhea in a woman may be contracted from an acute or chronic gonorrhea of the man, and vice versâ.

From a clinical standpoint one of the most important characteristics of the gonococcus is its power of latency. This does not correspond biologically to the spore stage of some other bacteria. It means that the organism remains living in the human tissue, but is temporarily inactive. It means that the patient has gonorrhea without symptoms. The gonococcus, lurking as it does in the interstices between the epithelial cells, is comparatively safe from injuries which do not destroy the cells, so that it may remain dormant for long periods of time until stimulated into activity by changes in the circulation of the surrounding tissue. The limit of the period of latency which the gonococcus may possess is a matter of conjecture and is placed by different authorities from two to ten or more years. Probably three or four years is the average

limit in man and a somewhat longer period in woman. Reports of cases of latency of twenty-five and twenty years are to be received with doubt.

The favorite lurking places for the latent gonococcus are in the secluded and well-protected folds of certain tissues for which it has a predilection. Examples of these are the prostate gland in the male, and in the female the ducts of the cervical and vestibular glands, and the rugæ of the lining membrane of the Fallopian tubes. The latent germ may light up into acute activity in two ways: it may either produce a fresh gonorrheal attack in the individual in whom it has been residing as a latent parasite, or it may be transferred to another individual, and, finding there a fresh soil more congenial to its growth, incite an acute process. The condition that favors an awakening of a latent gonorrhea is the bringing of fresh nourishment to the tissue in which it exists as a result of hyperemia, such as may be elicited, for example, by excessive venery, menstruation, childbirth, and ill-advised pelvic operations.

It is this power of latency which makes the gonococcus so treacherous an organism, and which renders so futile the efforts to prevent the extensive ravages that the disease makes on the health of the human race.

According to Amann, it is probable that the gonococcus does not pass through a true incubation time, but rather begins to grow and multiply in a very short time after being deposited. The reaction in the tissues appears within from twelve hours to two days, and, according to Amann, never more than three days. Norris, on the other hand, gives an incubation period averaging three days to a week.

The various phases of gonorrheal disease in woman are determined by the predilection which, as we have seen, the gonococcus has for certain surface tissues of the body. To meet the requirements for the active development of the gonococcus the tissue must be soft and delicate, continually moist, and well supplied with blood. The surface may be modified epithelium, like that of the urethra or the delicate squamous epithelium of the vagina, or it may be cylindric mucous epithelium, like that of the endocervix, or it may be the endothelium of the pelvic peritoneum or the delicate epithelium of the conjunctiva.

The surface epithelium of the various parts of the female genital system offers favorable soil for the growth of the gonococcus, and the infection of each one of these parts constitutes a special disease, which may either exist as an affection by itself or be associated with infections of other areas of the genital system.

The parts of the genital tract which may be infected to a greater or a less extent are: (1) the vulva and vagina (of children); (2) the urethra; (3) Skene's or para-urethral glands; (4) Bartholin's glands; (5) the endocervix; (6) the endometrium; (7) the endosalpinx; (8) the ovaries, and (9) the pelvic peritoneum. An understanding of gonorrhea in women may best be gained by a successive study of the infections of these parts, and we will, therefore, proceed to consider the subject under the following topics: (1) Vulvovaginitis; (2) urethritis; (3) inflammation of Skene's glands; (4) Bartholinitis; (5) endocervicitis; (6) endometritis; (7) salpingitis; (8) ovaritis, and (9) pelvic peritonitis.

Extragenitally the gonococcus may infect the anus, the mucous membrane of the rectum, the conjunctiva of the eye, and the mucous membrane of the mouth and nose of the newborn. These infections, however, constitute diseases which do not come within the scope of this book, and are, therefore, only to be mentioned in passing. It should also be noted that the gonococcus has no tendency in women to ascend into the bladder and kidneys, and that, therefore, the urinary tract, with the exception of the urethra, ordinarily takes no part in a gonorrheal attack, no matter how extensive the disease may be in the genital system.

## Gonorrhea in Children

**Vulvovaginitis.**—Primary gonorrheal infection of the vulva and vagina is a disease which affects children or young girls almost exclusively. This is due to the fact that the modified squamous epithelium of the vulva and vagina in children and early youth is soft and delicate. It is extraordinarily susceptible to gonorrheal infection. As the child develops into adult life the surface epithelium of the vulva and vagina becomes somewhat cornified and more resistant, so that in adult life a primary infection of the vulva or vagina is rare. In very severe or badly neglected cases these parts may become secondarily involved in the adult, but when this occurs there is usually a mixed infection of organisms other than the gonococcus.

The mode of infection of vulvovaginitis in children is often difficult to determine. A few cases in the lower strata of humanity can be traced to depraved sexual practices. The children of gonorrheal patients are exposed to infection by contaminated towels, sponges, and bed-linen. The lochial discharge of a puerperal woman in whom childbirth has lighted up a latent gonorrhea is a frequent means of infecting the child, for the lochia is an extremely favorable medium for the growth of the gonococcus. Such sources of infection as these just enumerated are sufficiently obvious, but when gonorrhea makes its appearance and extends from child to child in carefully regulated institutions, such as hospitals and schools, the mode of infection is often puzzling and difficult to trace. In searching for the cause of such epidemics it is useful to remember that *the disease can be transmitted only in the moist state.*[1]

[1] Rubin, who studied a series of 225 cases of vaginitis in children, noted an extraordinary discrepancy between the microscopic findings and the clinical evidence of the disease. He concludes that many of the cases of so-called gonorrheal vaginitis in children may not be due to a true gonorrhea. He says: "This evident contradiction between smear and symptomatology may be explained, first, by the fact that the gonococcus, if responsible for vaginitis in a child, is biologically different from that in the adult form of the infection, and, second, that the diplococcus seen in the smear is not a true gonococcus, though not distinguishable from it in appearance and staining characteristics.

"In favor of the first contention it must be emphasized that from the clinical side the very smallest number of children resemble closely the disease as met with in the adult. In the vast majority of them the common sequelæ are missing, such as ophthalmia, urethritis, joint involvement, and, most of all, peritoneal symptoms and complications.

"In regard to the microscopic resemblance to the true gonococcus it is known that vaginitis in children often is caused by Micrococcus catarrhalis (morphologically often indistinguishable in the smear from the gonococcus), by pneumococcus, meningococcus, streptococcus, and very often by the omnipresent Bacterium coli.

"That a true gonorrheal vaginitis does occur in children, however, cannot be denied. Its actual incidence probably is small. The definite diagnosis of such an infection cannot be based solely on smear examinations, but must be confirmed by bacteriologic cultural methods and serologic tests."

The clinical picture of a child with gonorrheal vulvovaginitis shows much swelling and redness of the external genitals, associated with pain and extreme tenderness. The parts are continually bathed with a profuse discharge of pus. The disease, like all forms of gonorrhea, is apt to last for weeks and months if not promptly treated at its onset. The disease has little tendency to ascend above the vagina into the uterus and tubes, but much damage may be done in the vagina as a result of the tendency to ulceration of the vaginal membrane with consequent plastic adhesions between opposing surfaces. This is one of the commonest causes of acquired gynatresia (see page 570). Various complications may arise. In a certain percentage of cases the urethra is infected, while in a still greater number the cervix becomes involved. Other somewhat infrequent complications are inguinal adenitis, cystitis, bartholinitis, condylomata acuminata, arthritis, ophthalmia, and proctitis. General peritonitis is occasionally seen, rarely the result of upward extension through the uterus and tubes, more commonly the outcome of a gonorrheal septicemia (Norris). Gonorrheal peritonitis is peculiarly favorable in its prognosis, and, if a diagnosis can be made, should be treated conservatively.

The *treatment* of gonorrheal vulvovaginitis in children is very difficult and requires great care and patience. During the acute stage there is often so much pain and tenderness that it is impossible to do more than keep the external genitals clean. Even this treatment, if properly carried out, requires much constant attention and can best be done in a hospital, where care must be exercised that other children be not contaminated.

Recurrences take place frequently after an apparent cure, due to minute non-cured foci. Their most common seat is in the cervix. According to Norris gonorrheal vulvovaginitis usually disappears shortly before puberty owing, as he thinks, to the marked development of the squamous epithelium at that time.

The treatment of gonorrheal vaginitis consists either of the local application of gonococcides or exposure to the drying process of hot air. The following detailed directions for carrying out these two forms of treatment are quoted from Norris and Mikelberg.

*Treatment with Dakin's Solution.*—The child is placed in the Trendelenburg position, with the hips well elevated and the thighs spread widely apart. The external genitalia and vulva are cleansed with cotton moistened with a 1 per cent. oily Dakin's solution (1 part Dakin's solution and 99 parts olive oil). About 3 drams of this solution are then introduced into the vagina by the means of a large medicine-dropper. The instrument known as the "Little Jumbo" dropper has proved satisfactory for this purpose. The solution is injected into the vagina somewhat slowly, after which the instrument is quickly withdrawn, and the labia held together with the gloved fingers for about two minutes. The excess oil is then wiped off. This treatment is administered by the physician twice weekly, and the mother is instructed in the method of its application. She is furnished with 3 ounces of the solution and a dropper, and is directed to

apply the treatment night and morning. The infectious nature of the discharge is explained to her, and she is cautioned regarding prophylaxis, and especially as to the danger of conjunctivitis. In addition, each mother is given a card that tells in simple language of the infectious character of the disease, how it is spread, and the necessity for prophylaxis regarding towels, toilet-seats, etc. The importance of continuing the treatment until the infection is entirely eradicated is also emphasized.

Intensive treatment of the urethra and cervix is generally necessary during the end stages of the disease, and for this purpose mercurochrome has usually been employed. This treatment is similar in general character to that employed for cervitis and urethritis in the adult. Among dispensary patients, if a child does not do well under the treatment, a social worker is directed to visit the home for the purpose of ascertaining if the home treatment is being properly administered. If, during the course of treatment, the child is not brought to the clinic regularly the services of a social worker are again enlisted.

*Treatment with Hot Air.*—This is resorted to in resistant or recurrent cases. The patient is placed in the extreme Trendelenburg or, better, the knee-chest position; the external genitalia are cleansed; a Skene bivalve wire urethral speculum is then introduced into the vagina. If the lower bowel and bladder are empty and the child is in the proper position the vagina will balloon out.

The vagina is then thoroughly cleansed with absorbent cotton moistened in a non-irritating, antiseptic solution. A 1 : 10,000 or 1 : 15,000 potassium permanganate solution is satisfactory and is a moderately good mucus solvent. This cleansing should be done under good illumination, a head mirror being employed to throw the light into the vaginal canal. The vagina is then dried by means of absorbent cotton, and followed by hot air, until the vaginal lining and portio vaginalis assume a glazed appearance. A dentist's hot-air bulb may be employed for the latter purpose. With the speculum in place, the child is allowed to slip from the knee-chest posture down into the Sims left lateral position, with a pillow under the hips. The patient is kept in Sims' position with the speculum in place, and the vagina ballooned out for from twenty minutes to half an hour. It is important to see that the ballooning out of the vagina is maintained. If hot air is not obtainable, the child should be kept in Sims' position a somewhat longer time. Thorough drying is essential.

As a final step the entire vagina, portio vaginalis, and external genitalia are liberally painted with a 1 or 2 per cent. mercurochrome solution, or any other gonococcide that may be desired. Intensive treatment to the cervix and urethra is also applied. This treatment is employed three times a week, and in the interval the mother or nurse applies a 1 per cent. mercurochrome or a 1 per cent. Dakin's solution twice daily, as previously described. In cases in which the hymenal opening is unusually small it is best to incise this membrane as a preliminary step, thus facilitating treatment and aiding drainage. This method of treatment has the disadvantages of being time consuming and

difficult of application unless a certain amount of co-operation from the patient can be secured. (Copied from Norris.)

When the disease appears in young girls just past the age of puberty in whom local treatment is more feasible, it is also best when possible to put the patient to bed in a hospital under the care of a competent special nurse. From four to six hot cleansing douches should be given daily, while every day or every other day an injection of protargol (5 to 10 per cent.) may be administered. The discharge under this treatment is quickly controlled, but the treatment should be kept up for from ten days to three weeks or more. The patient on returning home should keep up the daily douches under the supervision of her mother or a nurse. If the disease becomes recrudescent, the patient should receive again the hospital treatment. It is impossible to tell at a given time whether or not one of these patients is completely cured, as the microscopic examination of the vaginal secretion is quite misleading if the report is negative.

Excellent results have been reported from the use of gonococcal vaccines, which seem to be more efficacious in the treatment of the vulvovaginitis of children than in any other acute form of gonorrheal disease.

## Gonorrhea in the Adult

### URETHRITIS

In gonorrhea of the adult the primary infection takes place in the majority of cases in the urethra. Just how often this occurs is somewhat difficult to determine, and the estimates of primary urethritis vary from 60 to 90 per cent. This uncertainty is due to the fact that the disease in the urethra is often very slight and attracts little attention on the part of the patient. As the more serious symptoms of ascending gonorrhea often do not appear for several weeks or months after the primary urethritis, the association between the two phases of the disease may be lost. This probably occurs in the majority of cases in adults. Next to the urethra as a point for primary infection, the endocervix holds second place, while the vagina is primarily infected rarely except in the young. That the urethra should be usually first attacked is logically to be expected, for the epithelium of the meatus being, in the female as in the male, an extremely favorable medium for the growth of the gonococcus, is the first of the susceptible points of the external genitals to be exposed to infection during coition. It often happens, of course, that more than one point may be infected at the same time. The urethra may also be infected secondarily from a primary focus in the cervix, and it is probable that this is often the case, for the meatus is so situated in the vestibule that leukorrheal discharge from the vagina almost inevitably becomes lodged to some extent between the folds of tissue which envelop the urinary orifice. The disease is usually confined to the lower third of the urethra.

There is no doubt that the transmission of an acute gonorrhea from the man is more apt to cause a primary infection in the urethra, or in the urethra and cervix at the same time, while a chronic gonorrhea of the man might be expected first to attack the cervix.

In the young, or where the external orifice is proportionately small, the urethra is primarily infected, while in those who have borne children or who have a relaxed vaginal outlet the cervix is more apt to be first affected.

The picture of a well-defined gonorrheal urethritis is very characteristic and almost pathognomonic. The vestibule is reddened and tender and bathed in pus. The meatus is pouting and swollen, while from the urethra can be expressed a thick creamy pus, a smear from which shows the gonorrheal diplococci in greater or less abundance. In making a diagnosis of urethritis it must be remembered that the reddening of the vestibule and the eversion of the meatus may persist after the urethritis has healed, especially if there has been an associated infection of Skene's glands. Then, too, a vaginitis or endocervicitis may cause a leukorrhea which bathes the vestibule, a part of the secretion being deposited in the opening of the meatus. This leukorrheal deposit often looks like the pus from a urethritis. In testing, therefore, for a urethritis it is always best to wipe the vestibule and meatus thoroughly before attempting to express pus from the urethra. Urethritis may be caused by the colon bacillus and other organisms, but many cases of urethritis from this cause are the result of previous damage done by a gonorrheal infection.

**Symptoms.**—As has been noted, urethritis in a woman may come and go without producing any noticeable symptoms. Sometimes there may be a mild temporary discomfort in urinating which is no more severe than the irritation which most women occasionally experience from a concentrated urine. A typical case of urethritis in the female is quite similar in its initial symptoms to that in the male. There is first a sense of discomfort and then a burning from urination, followed by a purulent discharge, which may or may not be observed by the patient. This pain on urination is sometimes extremely severe, and may be accompanied by ulceration and bleeding from the urethral mucous membrane. The swelling of the external genitals often gives a sense of pelvic pressure, so that the patient not infrequently consults her physician, thinking that she has a prolapse of the womb. The course of the disease, as compared with that in the male, is less severe and less definite. The duration of the average case is from three to six weeks, but the acute symptoms usually last only a few days. The disease has little tendency to ascend in the urinary tract unless carried up by improper local treatment. Occasionally gonorrheal urethritis persists and becomes chronic, but when this happens there is usually an associated inflammation of Skene's glands, which has an influence in maintaining the persistence of the urethritis. Such a case of chronic urethritis may last indefinitely and be very difficult to cure. The infection in time becomes mixed, and may persist long after gonococci cease to appear in the discharge. Discomfort on urination continues to a greater or less extent.

Acute gonorrheal urethritis, as we have seen, often heals spontaneously.

Many cases when under observation do not require local treatment of the urethra, chief attention being directed toward preventing the disease from ascending and attacking other parts of the genital system. The medical treatment for urethritis during the acute stage may consist of santal oil, 10 minims three times daily. As a urinary sedative the following prescription may be given: 5 minims of tincture of hyoscyamus and 10 grains of sodium bromid to 1 dram of liquor of potassium citrate taken every three hours (Block). The local treatment of urethritis is best carried out by injecting protargol (2 to 10 per cent.) into the urethra, care being taken not to force the solution into the bladder. The solution should be held in the urethra for several minutes by pressing a pledget of cotton against the meatus. The patient should urinate just before the injection and should abstain from urinating for an hour afterward. The solution should be used only in such strength as the patient can tolerate without pain. If the case is taken in time, ascending infection can usually be prevented by unremitting cleanliness, chiefly in the form of frequent vaginal douches.

Local applications to the urethral mucous membrane may be employed after a subsidence of the acute stage, usually two or three weeks after the onset. These may be made on a cotton swab consisting of a 5 per cent. solution of silver nitrate or a 15 per cent. solution of silver nucleinate. Such applications should be made only by an experienced person, as the urethral mucous membrane is readily injured by such a procedure in clumsy hands. It is also easy to lose the cotton swab in the urethra or bladder.

The **treatment** of chronic urethritis is, for the most part, devoted to the inflammation of Skene's glands, which usually accompanies and maintains the condition.

Stricture of the urethra as a result of gonorrhea is not common in women because of the comparative mildness of the disease and the slight permanent damage usually done to the urethral mucous membrane. The symptoms of stricture are like those in man—*i. e.*, frequent and difficult micturition and sometimes incontinence. Strictures usually yield readily to treatment, which consists either in slow dilatation without anesthesia or in forcible dilatation under an anesthetic.

## INFLAMMATION OF SKENE'S GLANDS

Skene's glands are small secretory structures situated on each side of the meatus, their function being probably that of lubrication, though this has not been clearly established. The ducts of these glands have minute exits near the meatus which simulate the duct-openings of Bartholin's glands at the introitus of the vagina. There is also a third gland, described by Schuller, which lies anteriorly, half-way between the other two. It is probable that Skene's glands may be primarily attacked by gonorrhea, but their infection is usually second-

ary to a urethritis. An inflammation of them is one of the stigmata of gonorrhea, for they are rarely infected specifically by any other organism.

Skene's glands when inflamed cause the meatus to look swollen and red. The ducts, which are normally hardly discernible, become widened and exude characteristic gonorrheal pus. The disease of the glands usually ceases with the healing of the associated urethritis, but the process may become chronic and exist as an independent disease for a long time. As in other chronic gonorrheal processes, the infection in time becomes mixed and the gonococcus crowded out by other organisms. The glands then remain as small pus-pockets which maintain a constant irritation of the meatus and urethra. This condition is a source of worry and mental distress to patients, especially if they are aware of the original cause of the trouble.

Sometimes the process burrows more deeply into the tissue and creates a chronic peri-urethral abscess, with an opening into the urethra through which it discharges pus either continuously or periodically. Chronic inflammation of Skene's glands may produce granulation, caruncles, or eversion of the urethral lining membrane. Sometimes the process causes permanent destruction of the meatus, so that the opening of the urethra is abnormally wide, a condition which may result in partial incontinence.

Inflamed Skene's glands which do not subside under treatment of the urethra may be injected with protargol or iodin by means of a blunt-pointed hypodermic needle or they may be destroyed by a cautery needle. Sometimes it is possible to split up the glands along the floor of the urethra, as they are tubular in form and run parallel to the urethral canal. When opened in this way the lining surface of the glands may be treated by local applications. The long-standing cases, especially those in which permanent pus-pockets are established, require careful dissection and excision.

### INFLAMMATION OF BARTHOLIN'S GLANDS

Bartholin's glands are two racemose glands, situated one on each side of the posterior commissure of the vaginal orifice, their physiologic function being that of lubrication. In the virgin the openings are close together, but in the relaxed vagina they are more widely separated. The minute openings of the ducts are usually discernible on inspection and can be marked by the two caruncular remains of the hymen, which lie one on each side of the vaginal opening and which persist till the membrane becomes smoothed out by the atrophy of later age. These two ducts form useful landmarks in operations for repair of the relaxed vaginal outlet.

Bartholin's glands may be infected primarily, but the infection is usually secondary to an infection elsewhere, especially in the urethra. They are rarely infected by any other organism than the gonococcus, so that an inflammation of them constitutes an almost unmistakable stigma of gonorrhea. The initial infection takes place in the short duct of the gland. Other pyogenic organisms

in time take part in the inflammatory process and crowd out the gonococcus. The infection may then extend to the main part of the gland, and an abscess be established which may become acute at once or lie dormant, to light up at some later period. The initial infection may pass unnoticed and no evidence of disease in the gland appear till long after other manifestations of gonorrhea have disappeared. As a rule only one gland is affected, but both glands may become inflamed either simultaneously or at different periods.

Inflammation of Bartholin's gland is almost sure to recur if the gland is not entirely excised. This recurrence may take place at any time after the first

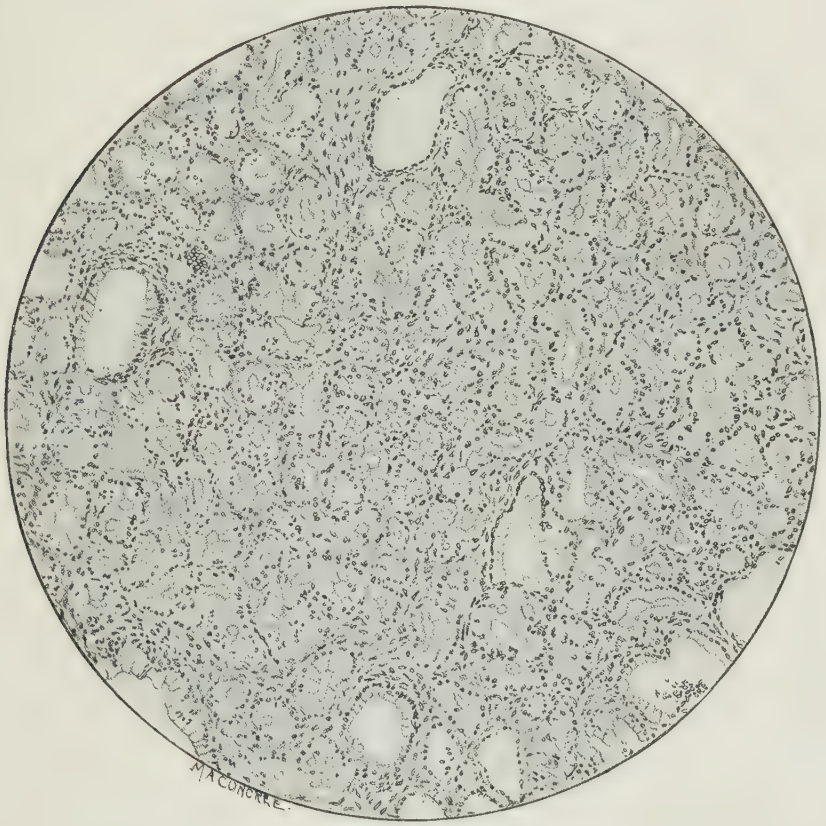

FIG. 28. —BARTHOLIN'S GLAND.

Low power. General view of the structure consisting of glands of the racemose type cut across, lying close together, and in some places dilated. At the top is seen a duct.

infection, often appearing years later. The nature of the recurring inflammation may vary from a slight thickening and tenderness of the gland up to an enormous abscess. The clinical picture of an abscess of Bartholin's gland is very characteristic. The swelling of the gland causes a deviation to one side of the usually straight line of the introitus, and, on inspection, can readily be recognized at a glance. There is exquisite pain and tenderness in the acute stages. On separating the labia the parts appear red and inflamed and bathed in pus if

the abscess occurs during the primary gonorrheal attack. The recurrent abscesses are often milder in their course.

The **treatment** of Bartholinitis is complete excision of the gland whenever it is possible. In the very acute cases it is necessary first to incise the abscess and evacuate the pus, and then dissect out the gland as soon as the wound becomes clean and granulating. In the recurrent type, where the inflammatory process is milder, the gland can be excised entire without spilling the pus until the last cut is made across the duct. This is preferable to evacuating the abscess first,

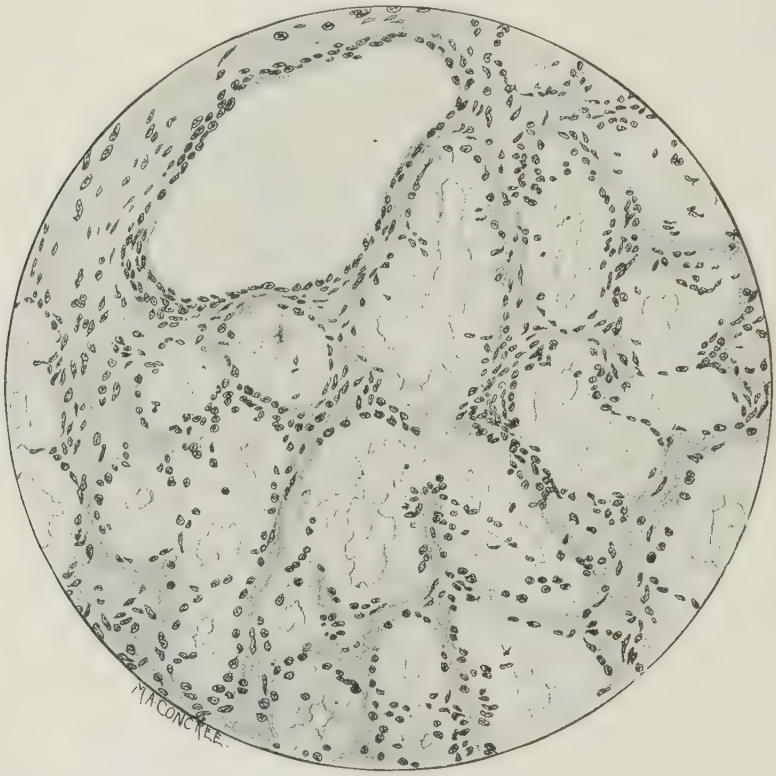


FIG. 29.—BARTHOLIN'S GLAND.

High power. From top of same section as previous drawing, showing the duct which is lined by low cuboidal epithelium and the glands which are lined by a single layer of high cells which secrete mucus.

because the gland after being emptied collapses and the dissection of the sac is rendered more difficult. A description of the operation for Bartholinitis is given on page 625.

Between the recurrences of inflammation the gland usually regresses in size to such an extent that it can hardly be felt on palpation. It is better not to operate during this stage, as it is difficult to find the gland during dissection and differentiate it from surrounding tissues. An operation at this time is apt to result in considerable mutilation, with the possibility of leaving some of the

gland structure behind. If it is desirable to operate on the gland during its collapsed stage it may be distended by injecting methylene-blue through the duct by means of a hypodermic needle. The surgeon will thus be guided by the colored tissue in carrying out his dissection.

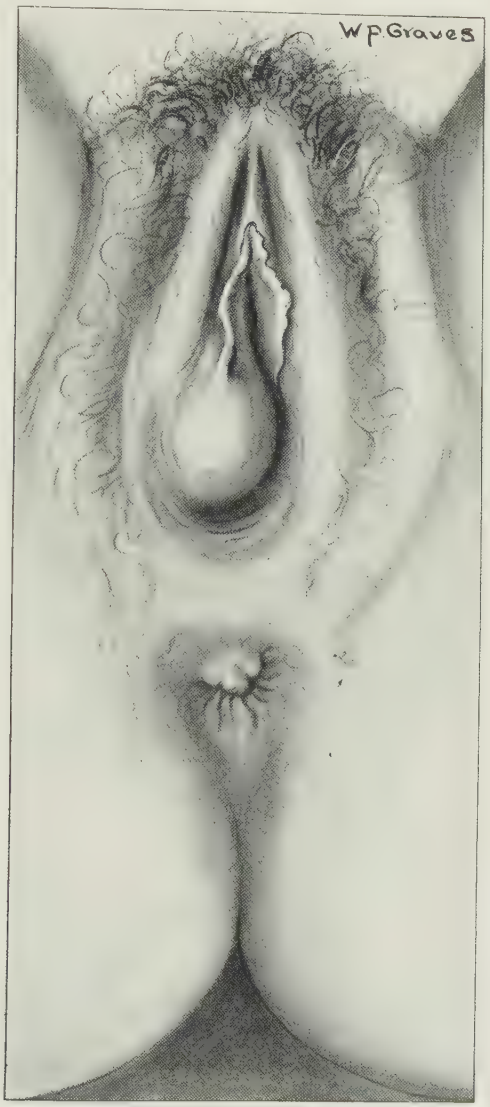


Fig. 30. — Cyst of Bartholin's Gland.
It shows the characteristic swelling on one side of the introitus. Abscess of Bartholin's gland gives the same outward appearance.

It sometimes happens that the inflammatory process in the gland entirely subsides, leaving the duct occluded. Secretions of the glandular cells may then cause a retention cyst. This is a late phase of Bartholinitis and does not

appear until long after the active process has ceased, sometimes many years after. These cysts may regress and then recur after considerable lapse of time, or they may become permanent and slowly grow into quite large tumors. They

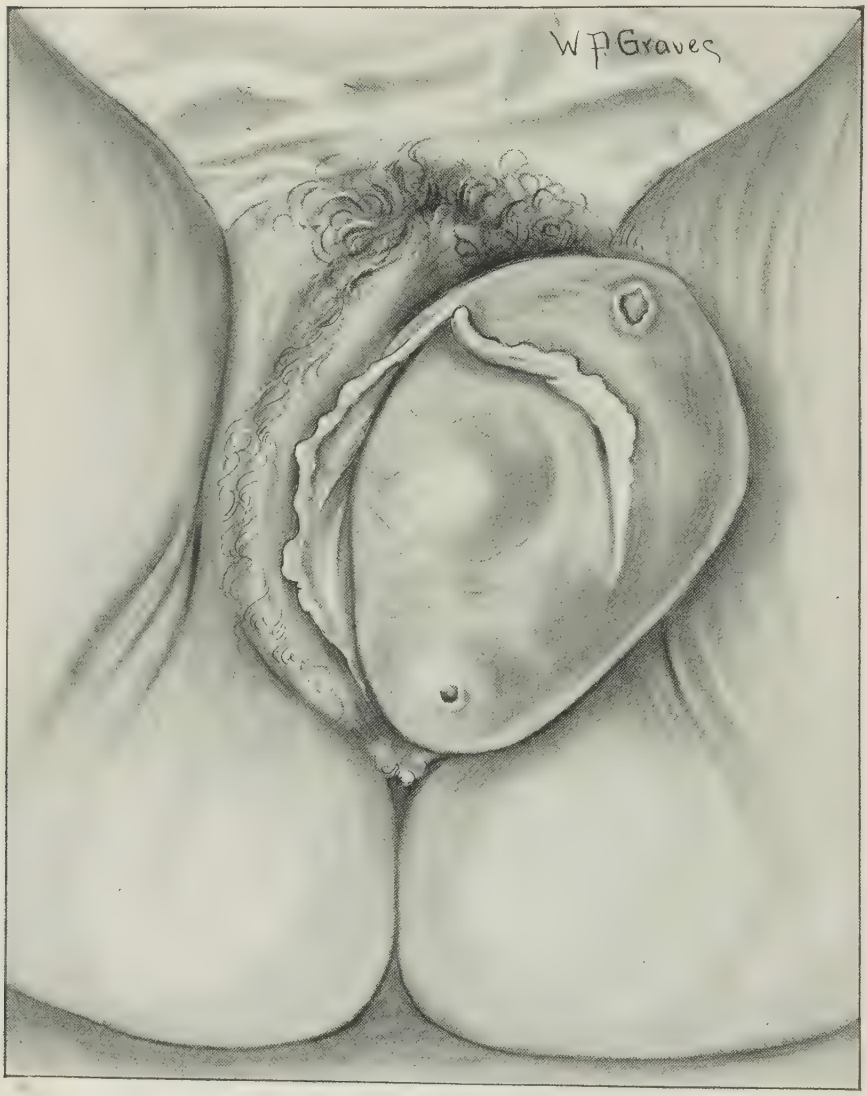


Fig. 31.—Large Cyst of Bartholin's Gland.

Drawn from an elderly woman who had carried the tumor for many years. The vulva was distorted and the cyst pressed on the urethra so as to interfere with urination. The cyst was dissected out entire without rupturing it. There was no connection with the inguinal canal.

do not give much pain, but they often interfere with coitus and sometimes cause urinary symptoms. Cysts of Bartholin's glands are nearly always consequent upon an old gonorrheal infection and, therefore, are to be regarded as fairly reliable stigmata of the disease.

The treatment of Bartholin's cysts is always total extirpation on account of their tendency to recurrence. In operating, the incision should be made through the skin and not through the soft modified membrane of the introitus near the duct. By careful dissection the cyst may be removed entire. If it is punctured, the cyst collapses and the dissection then becomes ragged and mutilating. It is to be remembered that the clean removal of a Bartholin's gland or cyst is not a particularly easy operation. The dissection must be carried deeply into the paravaginal tissues, and there is often troublesome bleeding. The operation should, therefore, not be attempted under local anesthesia. (See page 626.)

Another phase of recurrent Bartholinitis is an inflammatory thickening of the gland, which gives considerable discomfort or pain. The gland may not be large enough to be discernible on inspection, but can be felt between the thumb and forefinger placed just inside the introitus. No matter how small the gland may feel, if it is giving symptoms it should be excised, for nagging discomfort of the perineal region, from whatever cause, is liable to be a source of nervous irritation, which may develop serious consequences out of all proportion to the gravity of the original lesion.

## CERVICITIS

Gonorrheal condylomata of the cervix have been described, but they are extremely rare. They may occur singly as isolated pedunculated tumors or in papillomatous clusters spreading over the cervix. They may be associated with similar lesions of the vagina, vulva, and perineum (L. R. Wharton).

## ENDOCERVICITIS

Before taking up the gonorrheal infections of the endocervix and endometrium it is advisable to review briefly several important facts about the structure of the cervix and body of the uterus which are not always sufficiently emphasized. It is a good plan to regard the fundus and cervix of the uterus as two very distinct organs, which differ from each other more or less essentially in their histologic structure, physiologic functions, and in the pathologic processes that affect them. We shall have occasion often to refer to this fact as we proceed in the study of uterine conditions.

The mucous membrane of the cervix is very different from that of the fundus. In the endocervix the membrane is composed of complicated racemose glands, with small ducts emptying into the cervical canal. The epithelium lining the cervical glands is of the high cylindric goblet-cell type. These glands secrete a *true mucus*, which, as we shall see later, is of great importance in many ways. The endocervical mucosa is thrown into definite rugæ, radiating from a central line, an arrangement commonly called the arbor vitæ. These folds are of clinical significance in inflammatory processes of the endocervix.

Toward the internal os the mucous membrane becomes modified, the glands become less arborescent, and the high cylindric epithelium becomes lower in type. At the internal os the mucous membrane of the cervix merges into the mucosa of the body or the endometrium.

The endometrial mucous membrane consists of simple tubular glands lined with a low cuboidal epithelium. The surface epithelium of the canal is of the same type, but ciliated. The

endometrium produces a thin secretion which is not true mucus. We thus see that the endocervix and endometrium are unlike both histologically and in their physiologic functions. They also differ in the manner in which the same infection may affect them.

Normally the internal os acts as an efficient barrier to all organisms excepting the gonococcus, the tubercle bacillus, and the spermatozoön. If, however, the os be artificially dilated, or if it become patent as a result of parturition, infection is possible from any pathogenic germ.

Thus it is that in the non-impregnated uterus ascending infection in the endometrium and tubes rarely occurs excepting from gonorrhea. The endocervix, however, is more suscep-

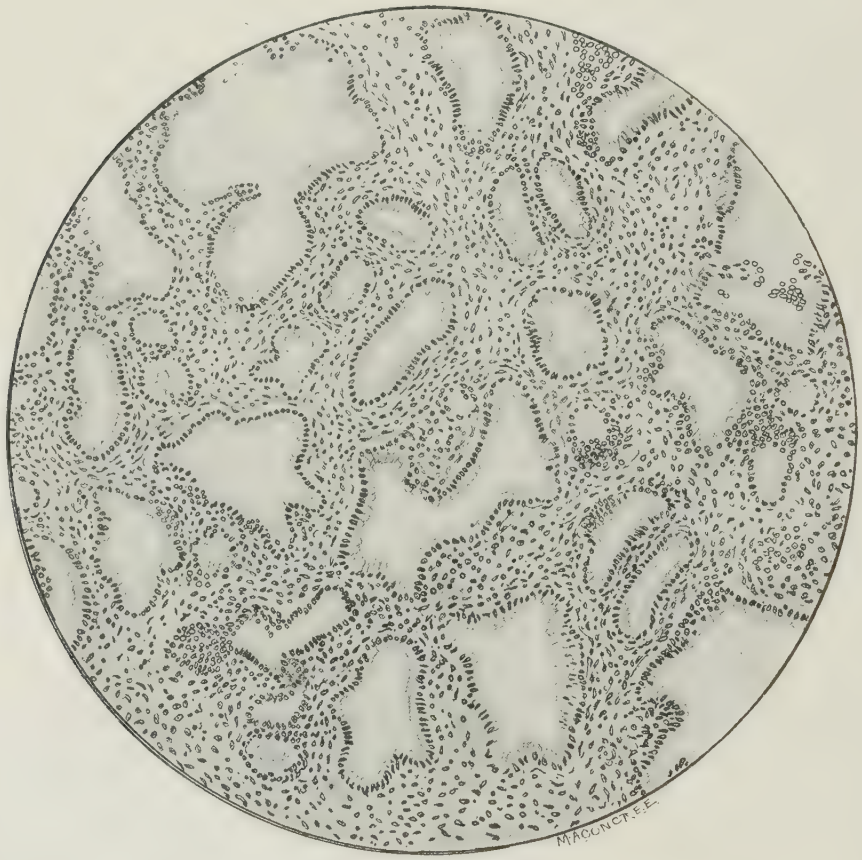

FIG. 32.—GLANDS OF THE CERVIX.

Low power. The glands are shown in cross-section. They are lined by cylindric cells, the nuclei of which lie at the base, leaving a large amount of clear protoplasm. These glands lie in the connective and muscular tissue of the cervix, not having a cytogenous connective tissue around them as do the glands of the endometrium.

tible to infection, as the external os affords less protection and the mucous folds of the cervical mucosa constitute a favorable soil for various organisms. Especially is this true of the gonococcus.

Gonorrheal infection of the endocervix may be primary or secondary. How frequently it is primary is a matter of conjecture, and opinions vary considerably, some placing the figure as low as 10 per cent. and others as high as 40 per cent. It is possible that many of those cases whose first noticeable symp-

toms are from a salpingitis have been primarily infected in the cervix. This is a reasonable conclusion, because the cervix is one of the most insensitive parts of the body, and diseases of the organ, inflammatory or otherwise, give little or no pain. The discharge resulting from the first infection may readily be overlooked by the patient.

It is likely that the endocervix is involved primarily or secondarily in most cases of gonorrhea. Acute gonorrheal endocervicitis in its primary stage is not often a matter of special treatment, excepting as it occurs as a part of a general complex infection. When seen the cervix is red and angry looking, with eversion and prominence of the mucous membrane. It causes some pain to the touch, and is said in some cases to be associated with tenderness of the inguinal lymph-glands. There is always present a profuse gonorrheal discharge mixed with mucous secretions from the cervical glands. Menstrual disturbances, usually in the form of menorrhagia, are common.

Chronic gonorrheal endocervicitis, on the other hand, is a special disease which is of great clinical importance and one that is very difficult to treat. The process of gonorrheal infection of the endocervical mucous membrane simulates that of Skene's and Bartholin's glands in that the infection occurs in the ducts of the glands. Later, a mixed infection of other organisms takes place gradually to the exclusion of the gonococcus, and the infection is then carried into the complicated lumina of the racemose glands. The irritation of the infection stimulates the mucous cells to a hypersecretion, so that a stream of mucopurulent material is continually poured out into the cervical canal, thus producing the constant leukorrhea which is so characteristic of the disease. In some glands the inflammatory process may cause a closure of the duct. The gland continuing to secrete without an outlet becomes a retention cyst. This process also takes place in all chronic inflammations of the cervix, with formation of retention cysts. They are commonly designated as Nabothian cysts from the name of Naboth, who first described the cervical glands. Nabothian cysts are filled either with clear mucus or with a cloudy mucopus, if the gland is infected.

Endocervicitis, unlike Bartholinitis, is not a stigma of gonorrhea, for it may occur as a result of the lacerations of childbirth or it may even appear in virgins. The endocervix is a favorite and treacherous place for the latent gonococcus to lurk, either in the folds of the lining membrane or in the ducts of the glands, ready to light up into later infectious activity under the hyperemic influence of coitus, menstruation, or childbirth.

When a chronic gonorrheal endocervicitis has been established the condition resembles somewhat that of gleet in the male. There is a persistent irritating leukorrheal discharge which the patient has difficulty in controlling, even with numerous douches. Douches have no curative effect on the disease, as they do not reach the seat of infection. They merely cleanse the vagina of the accumulated secretions and prevent to some extent the irritation which results from the

contact of the discharge with the external genitals. The influence of this constant leukorrheal discharge often has a disastrous effect on the nervous system of the patient, especially if she is aware of the original cause of her trouble. She feels herself degraded by her condition and, as her efforts for controlling the disease are usually unavailing, her health becomes impaired far out of proportion to the seriousness of the local infection. Endocervicitis must be regarded as one of the most important factors in the genital neuroses which play such a prominent part in gynecologic disease.

The **treatment** of endocervicitis should be applied directly to the endocervix itself. Applications of tampons and painting the vagina and vaginal portion of the cervix, like douches, do not reach the seat of the disease, but serve only to

FIG. 33.—CYSTIC DILATATION OF CERVICAL GLANDS.

Uterus has been opened longitudinally. The dilated cervical glands are seen in the lower part of the picture. Above is seen a submucous myoma projecting into the uterine canal. The tubes and ovaries are adherent.

keep the vagina clean. It is sometimes possible to cure the infection by repeated local applications to the cervical canal. A quicker but not infallible method is to curet and cauterize the endocervix. If all other methods fail, the rather difficult Schröder's or Sturmdorf's operation of removing the entire endocervix may be performed. (See page 641.)

In cases of active gonorrheal endocervicitis much can be accomplished by medical treatment if the patient can be well controlled. The treatment is most successfully carried out in a hospital with the patient maintaining absolute rest; if need be, in bed. The first part of the treatment consists in giving four or five hot douches daily of potassium permanganate (1 : 8000), alternating with boric acid (1 dram to the quart) until the active inflammatory condition of the cervix and vagina is allayed. Under proper conditions this result is attained in a surprisingly short time. Local applications may then be given every two or three days,

the douches being continued in gradually lessening amounts. In making local applications the essential points to remember are to clear the endocervix of mucus, and to dry the surface epithelium before applying the medicated solution. Block's technic is recommended. After exposing the cervix by a bivalve speculum the greater part of the discharge is wiped away. This process is greatly aided by spraying thoroughly with an alkaline solution. After cleansing and drying the vaginal portion of the cervix an applicator soaked in an alkaline solution (liquor antisepticus alkalinus) is passed into the endocervical canal to the internal os, in order to dissolve the tenacious mucus, which is always encountered. When the mucus has been removed the canal is dried by the passage of a cotton swab on an applicator. A 12.5 per cent. solution of silver nitrate is then applied to the canal, and immediately followed by an application of tincture of iodin.

If the patient is allowed to be up and about her usual occupations medical treatment is of little avail. When an early case of endocervicitis is met with, the patient should be advised of the danger of an ascending infection, and persuaded to submit to intensive continuous treatment, if possible, in a hospital.

Curtis has produced temporary cures by the use of autogenous vaccines made from selected anaërobic cultures. Kennedy believes that the ultimate seat of chronic infections lies in the interstitial tissue between the glands, areas which the operations of Schröder and Sturmdorf do not reach. He recommends the injection of a 25 per cent. solution of ethyl alcohol (1 to 2 c.c.) into the anterior and posterior lips of the cervix parallel to the canal, care being taken that the solution permeates the interstitial tissue and does not escape into the canal. Hollender and Grattiol introduce a dram of Beck's bismuth paste into the cervical canal two to four times a week, with good results.

It is necessary to emphasize at this point the fact that most leukorrheal discharges from the uterus are not from the endometrium, but from the *endocervix*. This is of great practical importance in the use of the curet, which is so often improperly applied to the endometrium instead of to the endocervix, where the real trouble lies. In this way very frequently serious infection is carried to the endometrium, and thence spread to the tubes and pelvic peritoneum.

## ENDOMETRITIS

The endometrium seems to be peculiarly immune to what may be called a permanent infection of gonorrhea. It must be that during the process of ascending from the endocervix to the tubes the gonococcus resides in activity on the mucous membrane of the endometrium for a time, but a true acute gonorrheal endometritis is rarely seen. The conclusion is that the endometrium serves as an efficient bridge for the passage of the gonococcus to the tubes, but that it is not a congenial soil for the organism to make a permanent abiding place. This fact is shown in the microscopic examination of uteri removed for acute adnexal disease, in which usually the endometrium presents no sign of active inflammation. Gonorrheal endometritis is not, therefore, often a disease for direct local treatment. If it does occur, and can be demonstrated, it should either be let alone or treated with great care. The curet is a dangerous instrument to use in such a case on account of its ability to extend the infection to the pelvic cavity or of lighting up pre-existing adnexal disease. Moreover, intra-uterine applications and douches are also fraught with danger.

In cases of long-standing pelvic inflammatory disease the endometrium is

sometimes found by microscopic examination to be in a condition of so-called chronic endometritis. (See page 256.) This is probably more often the end-result of puerperal sepsis than it is of acute gonorrheal endometritis. It may cause abnormal uterine bleeding during the recrudescence of pelvic inflammation. This makes the conduct of the case somewhat confusing, for it often leads to an ill-advised cureting, which may awaken the pelvic process into dangerous activity. Persistent leukorrhea is a constant symptom of chronic endometritis. Dysmenorrhea, sterility, and abortion are probably sometimes caused by it.

The **treatment** of chronic endometritis is rarely directed to the endometrium alone, as a diagnosis is made with such difficulty. The disease is, for the most part, treated in connection with chronic adnexal disease, with which it is usually associated.

## GONORRHEA OF THE TUBES

It is seldom that an infection of the tubes follows immediately a primary gonorrheal urethritis or endocervicitis. The internal os, an obstructive barrier to most microörganisms, is less effective against the gonococcus, and, though delaying its invasion for a time, may eventually allow it to pass through and attack the tubes. This may not occur for months or even years after the initial infection, and represents the awakening of a chronic latent endocervicitis.

The gonococcus, on passing the barrier of the internal os, proceeds to the tubes, doing very little damage to the intervening endometrium, which it uses more as a bridge than as a soil for permanent propagation. The tubal isthmus, though small in caliber, is an open portal for all fluids and organisms that pass the internal os, so that the gonococcus finds ready access to the tubal mucosa, the delicate folds of which are especially well adapted for its implantation and growth.

**Pathology.**—*Endosalpingitis.*—In the earliest stages of the disease the folds of the mucosa become swollen and reddened, while the lumen is bathed with an exudate which is more or less purulent, according to the severity or the duration of the infection. The tube itself becomes elongated and thickened; the fimbriated extremities are thickened, red, and angry looking. Up to this point the disease is a simple endosalpingitis (also called catarrhal salpingitis), and may represent the preliminary stage of a later and more severe inflammation, or it may be the limit of the disease. Both tubes may heal completely, or one tube may proceed no further in the process, while the other may go on to destructive changes. There is no doubt that both tubes are always originally infected. In some cases the endosalpingitis stage of the disease seems hardly to be noticed by the patient, while in others the pain and tenderness and constitutional reaction appear out of proportion to the amount of anatomic changes in the tube.

*Pyosalpinx.*—As the disease progresses it becomes more purulent in type. The epithelium of the mucosa, shorn of its cilia and rugæ or folds, becomes ulcerated and glued together. The wall of the tube becomes thicker as the inflammatory process extends into the muscularis and subserosa. The tubal ostium becomes closed, due probably to retraction and agglutination of the

fimbriæ, while a closure also takes place at the tubal isthmus. In this way a pus-sac is formed which may grow to very considerable proportions. The pus-tube is usually bent upon itself and becomes adherent to the posterior surface of the broad ligaments, though it may adhere higher up in the pelvis to portions of the large intestine and to the abdominal wall, or to the bladder. With the formation of a pyosalpinx there is always present an associated inflammation of the pelvic peritoneum, of the germinal epithelium of the ovaries, and of the

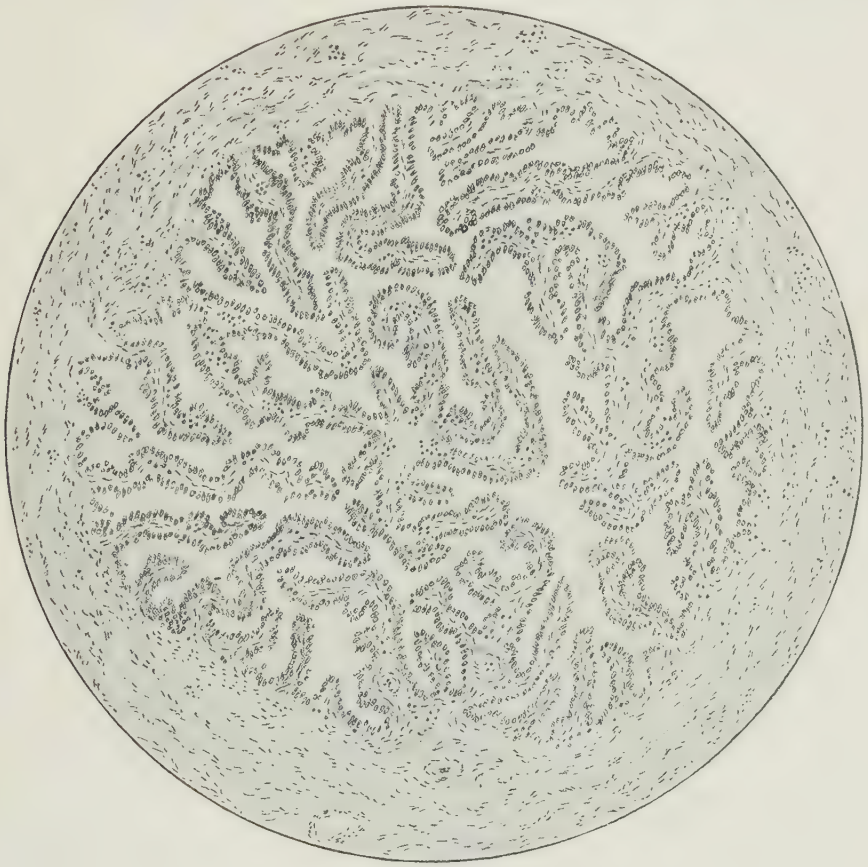

Fig. 34.—Normal Tube. Middle Portion.

Low power showing lumen. The lumen of the tube is very nearly filled by folds of mucous membrane called villi. These lie free in the lumen and consist of a connective-tissue stroma carrying blood-vessels. They are covered with ciliated, cylindric epithelium.

subperitoneal cellular tissue, especially that between the leaves of the broad ligament. Pyosalpinx occasionally becomes healed spontaneously, but, as a rule, it results in permanent damage to the pelvic organs and peritoneum.

*Tubo-ovaritis.*—The tubal extremity may become closed in another way than that described above. The exudate from the tube naturally flows over the surface of the ovary and the fimbriæ readily become attached to the ovary, thus closing the tubal exit. This is a common way for the tube to become occluded,

and the result is especially disastrous because the inflammatory process may include the entire ovary. In the first method the ovary usually escapes with, at most, only a superficial infection, but when the end of the tube is intimately attached to the ovary the purulent process may enter the substance of the ovary itself and destroy a considerable part of its tissue. Ordinarily, the albuginea layer of the ovary, which has rather a dense structure, is resistant to infectious organisms, but when a corpus luteum forms and bursts, the ovarian tissue over the area is temporarily a thin, non-resistant, practically necrotic structure, con-

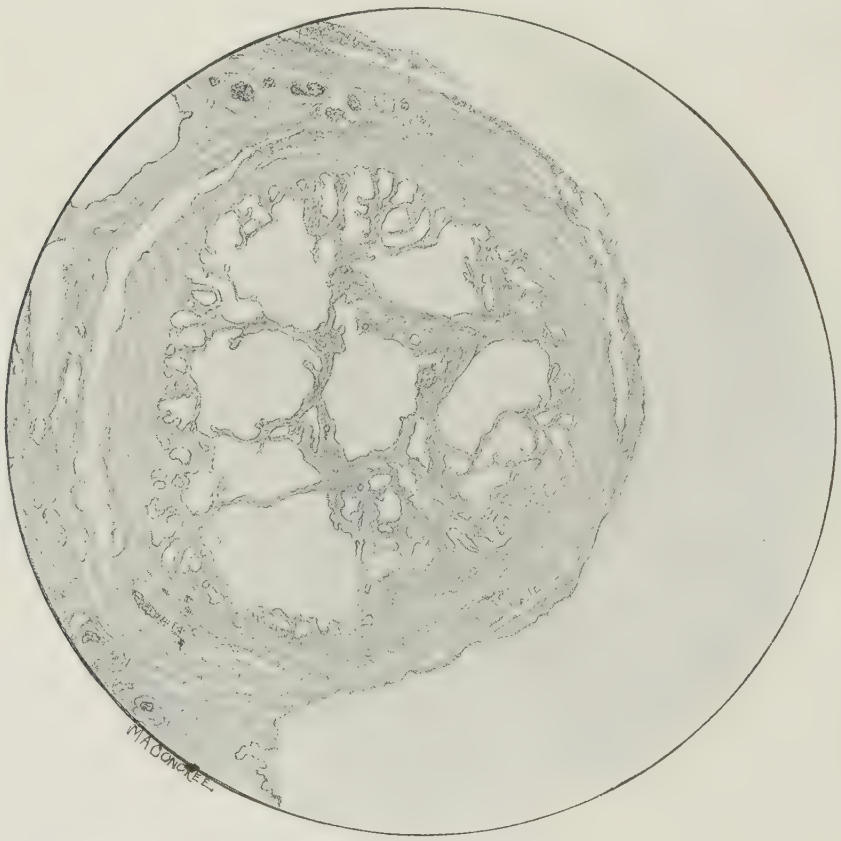

FIG. 35.—CHRONIC SALPINGITIS.

Low power. To illustrate the fusing together of the villi of the tube during an acute endosalpingitis. As can be seen by their fusion, they form spaces lined by tubal epithelium, which are called follicles. The process is now quiescent, the villi are not much swollen, though thickened in places due to the formation of connective tissue, and the wall of the tube is apparently normal.

taining a rent through which the ovum has been expelled. Moreover, the cavity of the corpus luteum, with its rich lining of luteal cells and its blood contents, forms an excellent bed for the implantation of the invading gonococci. If now the tube becomes engrafted on the surface of a regressive corpus luteum, the cavity of the corpus may easily become involved with the tubal abscess. As the abscess grows the containing sac is composed of the tubal wall and stretched-out ovarian tissue. This is called a *tubo-ovarian* abscess. The ovarian tissue

by this process is never completely destroyed, for even if both ovaries are implicated in an inflammation of this kind, no matter how extensive, ovulation and menstruation do not cease. The ovary, however, is permanently damaged and cannot be restored to its former condition. The progress of a tubo-ovarian abscess is the same as that of a sactosalpinx, excepting that its course is apt to be more severe.

*Hydrosalpinx.*—One of the manifestations of gonorrheal salpingitis is a cystic condition of the tube due to closure of the ostium, the wall being thinned out

Fig. 36. - Chronic Follicular Salpingitis.

Low power. This shows well the end-result following acute inflammation of the tubal mucous membrane. The villi become adherent to each other, fuse, and form the gland-like spaces, called follicles, which are seen. They are lined by the epithelium of the tube and do not extend into the wall. The process at this stage is quiescent, so that no infiltration with round cells is seen.

into a translucent membrane, and the contents consisting of a clear serous fluid. This is termed "hydrosalpinx" or "sactosalpinx serosa." It was formerly believed that the condition is an end-result of a tubal abscess in which the activity of the pyogenic organisms has ceased, and the pus elements contained in the sac have been gradually converted into a clear fluid. This theory is no longer held, and it is now thought that the process is serous from the start. Norris states that "most gonorrheal hydrosalpinges result from an inflammation which seals both ends of the tube and allows fluid to collect within the lumen. The mechanism,

under these circumstances, is very similar to that which produces a pyosalpinx, differing only in the fact that the inflammation does not progress to the stage of pus formation." In other words, it represents a mild and quickly aborted gonorrheal infection. It is also supposed that a hydrosalpinx may be formed after the active pus-forming stage of the disease as a result of a late sealing of the tube when the secretion has become serous. The change from the old belief that hydrosalpinx is a converted pyosalpinx is due to the investigations of Menge, who was unable ever to demonstrate bacteria in the fluid, and in the great majority of specimens examined could find no evidences of inflammation

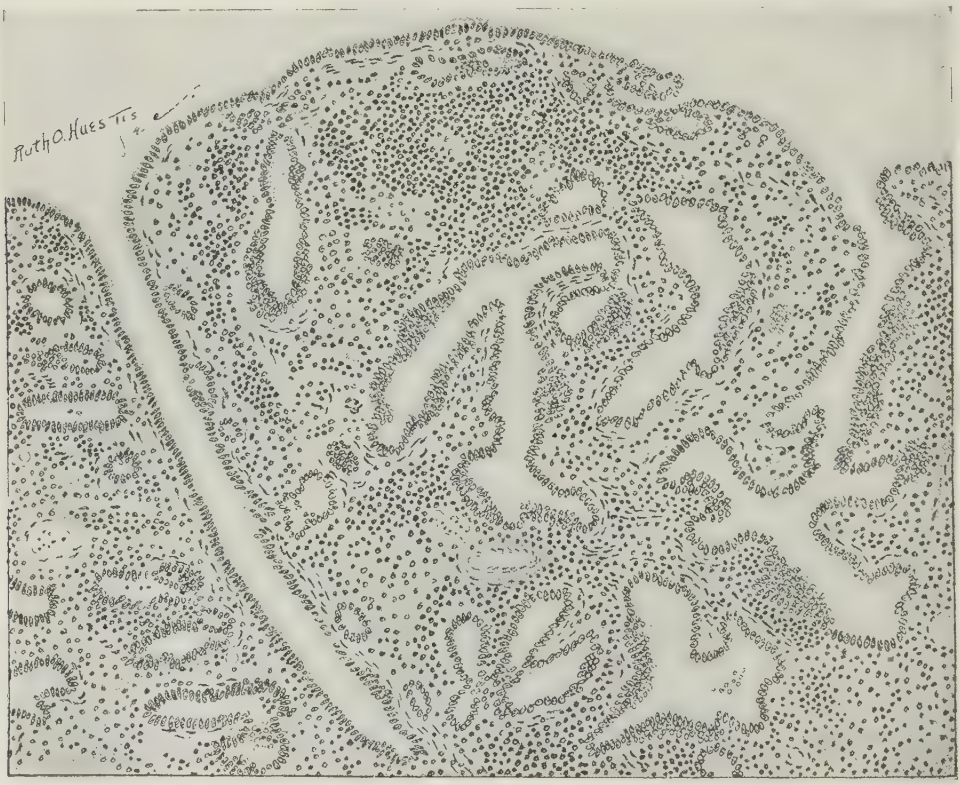

Fig. 37.—Chronic Salpingitis.

Low power of a part of the villi. The follicles, gland-like spaces formed by fusion of the villi, are well shown. There is edema of the stroma and a marked infiltration with round cells.

in the tissue of the wall. This he found always greatly thinned, with a lining mucous membrane which, though atrophied by pressure, was nearly always intact.

Hydrosalpinx may also be caused by a pelvic inflammatory process whose origin is outside of the tube, the closure of the ostium being the result of a perisalpingitis. In this way tuberculosis, puerperal infection, and appendicitis are, doubtless, accountable for a certain number of cases. Pelvic tumors which cause pressure adhesions, especially uterine myomata, are also included among the causes of hydrosalpinx.

*Tubo-ovarian cysts* may, theoretically, be converted tubo-ovarian abscesses. It is probable, however, that most of them indicate the adhesion of a tube to an ovarian cyst, with the later establishment of a communication between the lumen of the cyst and that of the tube.

*Hematosalpinx*, denoting a confined hemorrhage into the tubal lumen, is, in the great majority of cases, the result of an extra-uterine pregnancy or gynatresia. There is, however, no doubt that in both pyosalpinx and hydrosalpinx blood-

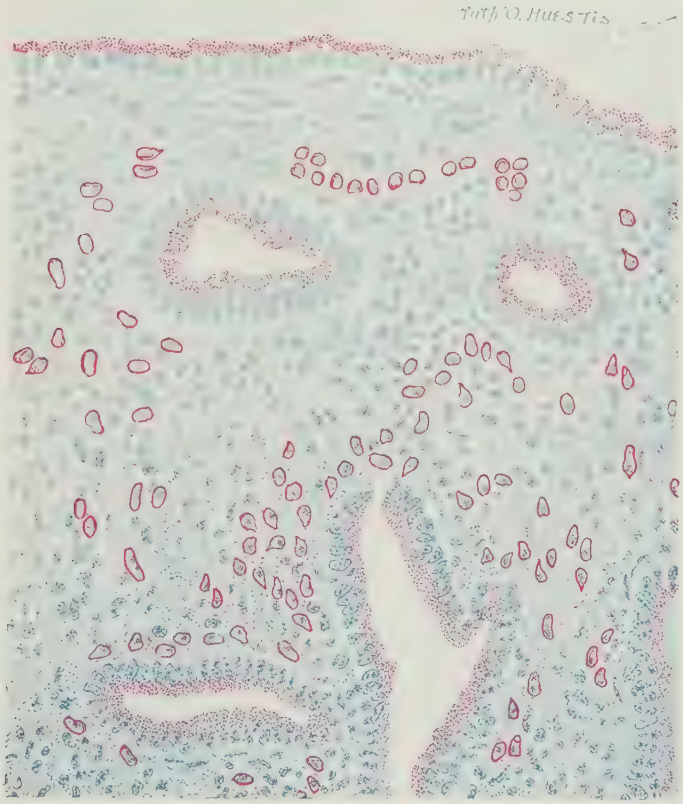

FIG. 38.—CHRONIC SALPINGITIS.

High power. This section is stained to show the plasma cells. These are derived from lymphocytes (Mallory) by a large increase in the amount of cytoplasm which has basophilic properties. They are also characterized by the excentric position of the nucleus, and may contain several nuclei. Their importance is that they are present in chronic inflammation.

vessels in the wall may be ruptured either by pressure or torsion, with consequent hemorrhage into the lumen.

*Gonorrhœa Isthmica Nodosa.*—The isthmus of the tube may be the seat of gonorrheal infection, which may be localized at this point or be part of a general tubal infection. The disease when seen is usually chronic, but may be acute, and is characterized by a hard nodule in one or both horns of the uterus, with occlusion of the tubal canal. This form of tubal infection is termed *chronic interstitial salpingitis*. A more scientific and descriptive name is *salpingitis*

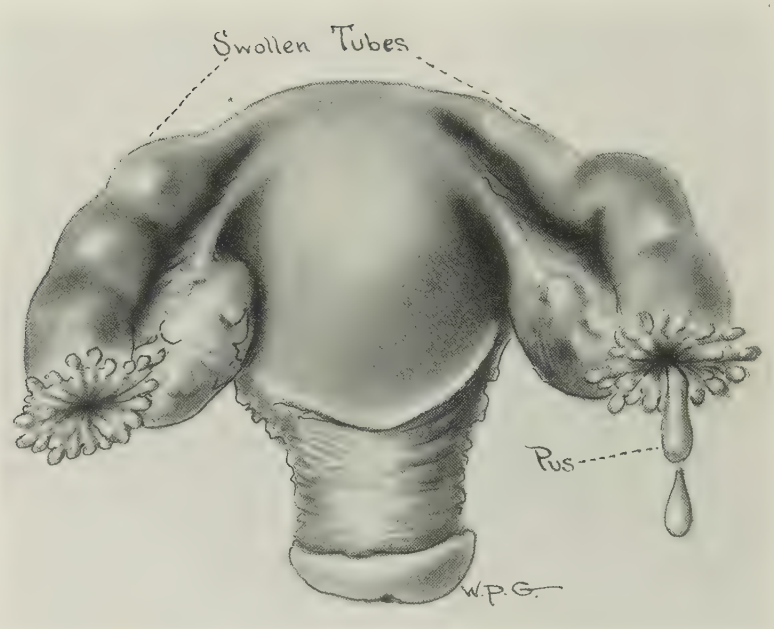


FIG. 39.—ACUTE PURULENT SALPINGITIS.
The tubes are greatly swollen and pus is seen exuding from one of the tubal ends. The fimbriæ are swollen and have not reached the stage of adhesion and closure.

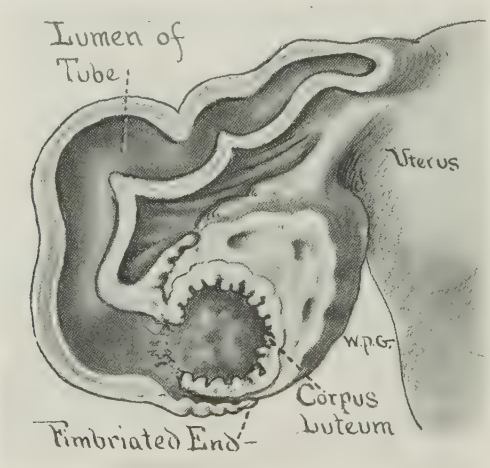


FIG. 40.—TUBO-OVARITIS.
Diagram showing how an inflamed tube may become attached to the ovary and communicate its infection to the ovary through the opening of a corpus luteum.

*isthmica nodosa*. The importance of this form of salpingitis is often overlooked by surgeons in performing a salpingectomy for gonorrheal disease when they simply amputate the tube at or near the uterine cornu. The isthmus of a tube removed in this way may later give trouble as a chronic interstitial salpingitis, or it may even light up into an active abscess of considerable size. When a

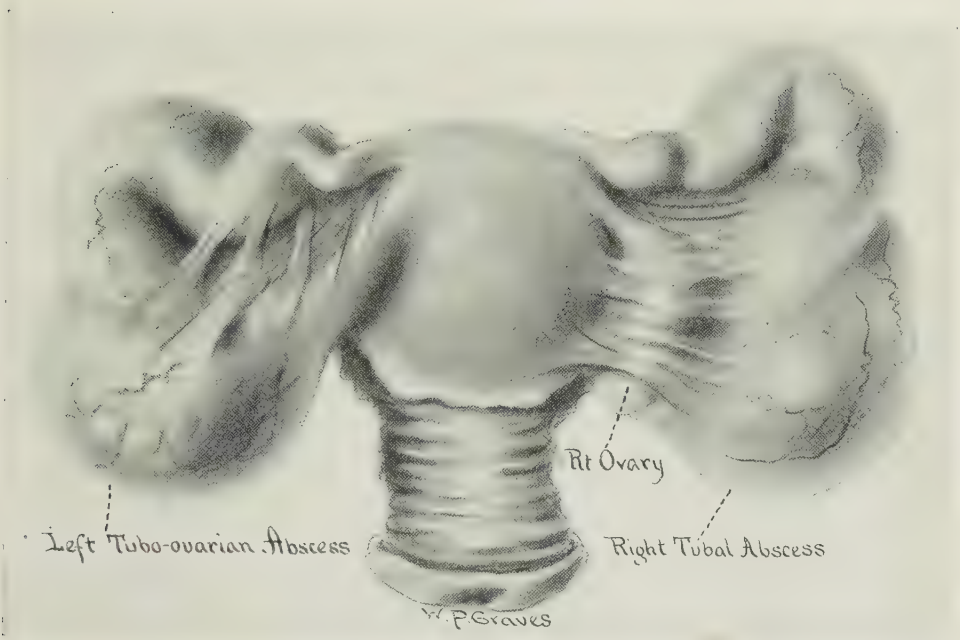


FIG. 41.—RIGHT TUBAL ABSCESS, LEFT TUBO-OVARIAN ABSCESS.

On the right is a tubal abscess distinct from the ovary which is seen buried in adhesions. On the left the tube and ovary are involved in a common abscess, the ovarian portion of the sac being represented with a slightly scarred surface.

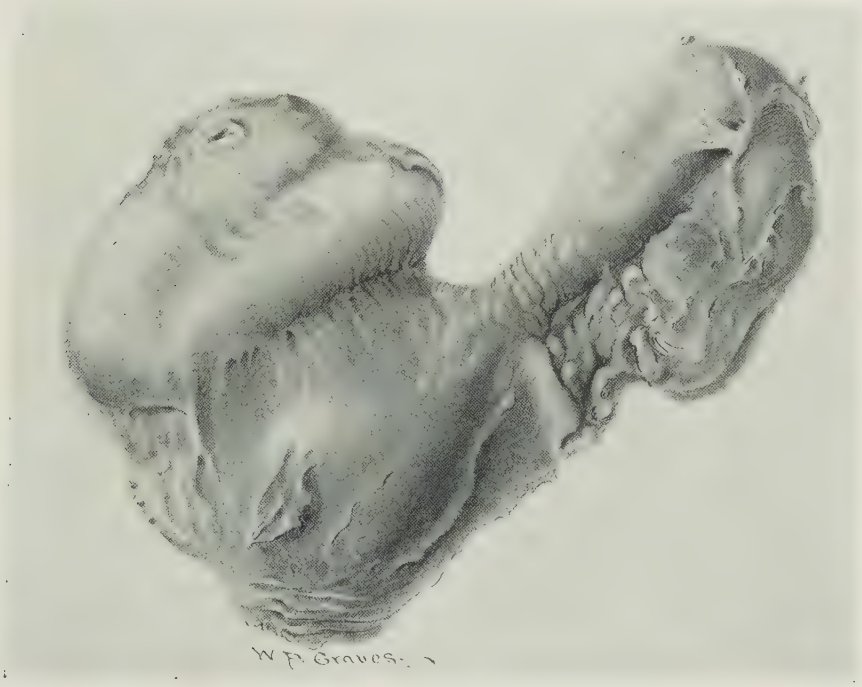


FIG. 42.—CHRONIC TUBO-OVARITIS.

In this case the tubo-ovarian masses became adherent to the fundus of the uterus. The mass on the left has been unfolded in the manner that should be employed during an operation for pelvic inflammation.

salpingectomy is to be performed for gonorrhea the tube should, therefore, be removed, isthmus and all, by a wedge-shaped incision into the cornu of the uterus.

The histologic appearance of a chronic salpingitis isthmica nodosa shows nests of gland-like columnar epithelium buried beneath the mucosa. It is commonly thought that this condition is a stigma of gonorrheal infection. There is no doubt that this is true in the vast majority of cases, but it is sometimes found in tubercular salpingitis. Occasionally the process represents an adenomyoma, in which case the tube may be patent and the patient may bear children, as in a case reported by A. H. Curtis.

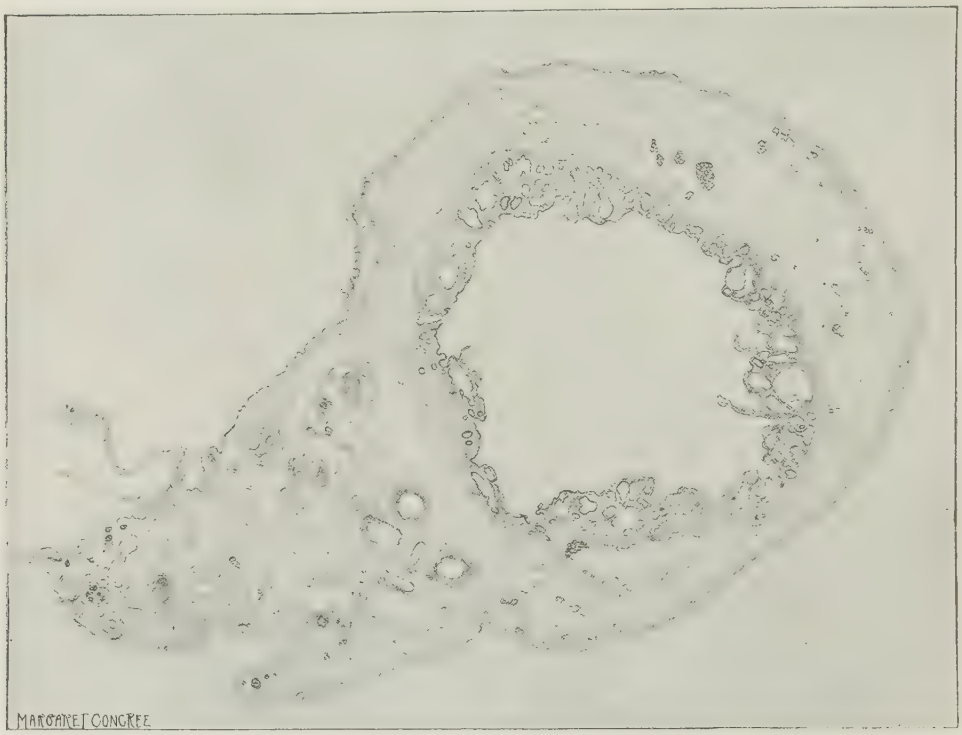


Fig. 43.—Hydrosalpinx.

Low power. The lumen of the tube is seen to be dilated. The villi have been inflamed, have formed follicles by fusion, and are seen as a gland-like layer around the inside of the tube. The wall of the tube is thickened, as is the mesosalpinx, which extends down toward the left lower corner. This is an early stage, so that the mucous membrane of the tube is not compressed and the wall of the tube is not thinned out.

*Pelvic Peritonitis.*—All cases of gonorrheal salpingitis are accompanied by a greater or less degree of pelvic peritonitis. This is necessarily so because the serous or purulent exudate from the tube inevitably flows from the fimbriated extremity and infects the peritoneal surface with which it comes in contact. The inflammation of the peritoneum produces a destruction of the epithelium of the peritoneum, with consequent gluing together of contiguous surfaces by adhesions. These adhesions are at first light and filmy and are easily broken up, but in the course of weeks, months, or years they gradually become more and more firm, until at last they are exceedingly tough and unyielding. They

also contract and produce serious dislocations of the pelvic organs. Pelvic adhesions resulting from gonorrheal salpingitis are of immense clinical importance, and patients suffering from this complication constitute a very large percentage of the cases met with in a gynecologic clinic.

The condition of adhesions following salpingitis is commonly termed *chronic pelvic inflammation*, or *chronic pelvic inflammatory disease*. In order to understand fully the clinical and surgical aspects of chronic pelvic inflammatory disease it is necessary at this point to consider the antomic changes which adhesions usually make in the pelvis. When one first operates on a severe case the pelvic organs seem to be in a hopelessly confused tangle, and an inexperienced operator is apt to get into serious trouble in trying to extricate them. As a matter of fact, the adhesions form in rather a definite manner, and if this is kept clearly in mind, cases which on first appearance seem utterly discouraging, may be disentangled with ease without injury to the patient. The keynote to the situation is that the posterior culdesac, or pouch of Douglas, is the lowest point of the abdominal cavity, whether the subject be standing, sitting, or lying, and as a consequence the fluid exudates of a pelvic peritonitis tend to gravitate to this point. The anterior pouch of the pelvis (uterovesical space), being at a higher level than the posterior, and out of range of the discharging ends of the tubes, remains comparatively free from infection except in very extensive cases. It is to be remembered, then, that the infective process is chiefly in the posterior half of the pelvis. When the adhesions form and become organized, the tubes and ovaries are folded backward and become adherent to the posterior leaves of the broad ligaments and the posterior wall of the uterus and vagina. They are also drawn downward deep in the pelvis. The intestines adhere to the surfaces of the organs, and the whole pelvis may thus become filled with a conglomerate mass, consisting of uterus, adnexa, and bowels, which it sometimes at first seems hopeless to extricate. These cases are, however, almost never inoperable if the dissection of the adhesions is carried out systematically.

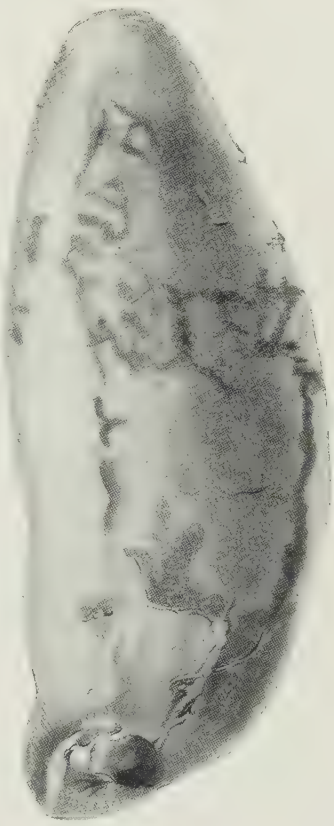

Fig. 44.—An Unusual Form of Hydrosalpinx.

As a rule, hydrosalpinx has more the form of a retort.

A practical point to consider in the pathology of pelvic inflammatory disease is its relation to retroversion and retroflexion of the uterus. Inasmuch as

the disease is usually confined to the posterior half of the pelvis, it is natural that the contraction of the adhesions should exert a backward pull on the uterus. In this way the uterus becomes firmly adherent to the bowel and adnexa in the position of retroversion. This constitutes the second most common cause for backward displacement of the uterus. The uterus may be folded back on itself into various degrees of retroflexion. It is possible that the center of the uterus may be drawn backward by adhesions without retroverting or retroflexing the uterine body, thus producing the position of anteflexion. Adhesions of the adnexa, acting unequally on the sides of the uterus, may produce a lateral version.

It is often important for the surgeon to determine whether or not the infection in a given case of salpingitis and pelvic inflammation is gonorrheal in origin. According to A. H. Curtis the prevalence of gonococcal infection amounts to 70 to 80 per cent.; of all cases of tubal inflammation 5 per cent. are due to tuberculosis, while the remainder are caused by the streptococcus, staphylococcus, Bacillus proteus or coli communis, chiefly the streptococcus. Of the inflammations that are not venereal or tubercular in origin the most common underlying pathologic causes are puerperal sepsis and unwise instrumentation of the lower genital tract. Curtis in his exhaustive study does not mention early *appendicitis*, a condition that is neglected by most writers. We have had occasion to emphasize the frequency of tubal involvement secondary to appendicitis and wish to reiterate it here. In private practice, where the venereal and puerperal infections are less common than in general hospital patients, the comparative percentage of appendical infections of the tubes will be found to be considerable.

The most important occasion for making a differential diagnosis is perhaps during an operation for pelvic inflammation from unknown origin in which conservation of organs and restoration to fertility is demanded. The fundamental principle to be borne in mind is that the essential process of a tubal infection from the gonococcus and tubercle bacillus is an *endosalpingitis;* whereas that which results from the other organisms is a *perisalpingitis*. The damage to the tubes is therefore much less in the latter than in the former case. The differential diagnosis may often be made during an operation by simple inspection of the tubes which are sometimes remarkably well preserved even in the presence of an extensive adhesive streptococcal infection. The mild pelvic inflammations such as may occur after an apparently uncomplicated abortion or after an early appendicitis often cause only an inversion of the fimbriæ with closure of the ostium. Light dissection of the tubal end will release the fimbriæ, which immediately effloresce in a natural manner. Such tubes when preserved resume their function as oviducts, often restoring fertility.

In some cases light is shed on the diagnosis by the nature of the adhesions and general appearance of the tissues. In tuberculosis the adhesions are apt to be very dense and tenacious, requiring cutting. The tubes are usually hopelessly damaged. After a single attack of gonorrhea the tubes may be easily freed of adhesions, but they usually show thickening and convolution of the wall with more or less destruction of the fimbriæ. Such tubes may sometimes be restored to function. Salpingitis nodosa usually indicates a gonorrheal process with occlusion, preservation of the tube being, for the most part, useless. Recently we have resected the nodes at the cornua and transplanted the cut ends of the tubes into the wound in a number of cases in which the main portion of the tube was not seriously damaged. Repeated attacks of gonorrhea or a primary gonorrheal infection followed by reinfection from other organisms, such as the streptococcus, causes dense intractable adhesions and thickened tubal walls, especially if there has been long-continued pyosalpinx.

Severe streptococcic infections such as may occur from puerperal sepsis produce adhesions comparable to those of tuberculosis, but the tubes may be little injured except by adhesions on their peritoneal surface. The fimbriæ are often only inverted by a purse-string-

like adhesion, or they may be partially or even wholly intact. A tubo-ovarian abscess or cyst usually indicates a gonorrheal origin. Cultures from a pyosalpinx are of some diagnostic value. If the culture is sterile, it is presumptive evidence of gonorrhea. Curtis has shown that the gonococcus does not live in the tube more than ten days or two weeks. He finds, however, that streptococci may be recovered months or even years after the acute processes subsided, in which case, however, the streptococcal infection may have been superadded to an original gonorrhea.

Histologic examination of tubes that have been removed will usually establish a differential diagnosis, a point which aside from its scientific interest is sometimes of value from a medicolegal standpoint. Gonorrhea, which primarily attacks the tubal mucosa, causes a characteristic thickening and gluing together of the villi from desquamation of the epithelium. The result gives the appearance of numerous gland-like pockets more or less filling the lumen and extending deeply into the wall of the tube. The fimbriæ are thickened and indurated, usually with complete closure of the ostium. In non-venereal salpingitis the "villi" are thickened, but do not produce the follicular appearance characteristic of gonorrhea.

It has been a general belief that plasma cells in the tubal stroma are pathognomonic of gonorrhea. Curtis has shown that although they are characteristic of gonorrheal salpingitis they are sometimes, though not constantly, observed in non-venereal infections.

**Symptomatology of Acute Salpingitis.**—The symptomatology of acute salpingitis is very varied. We see many cases with severe symptoms, but with very little anatomic change in the tubes, while, on the other hand, we frequently encounter extensively destructive changes in the adnexa in patients who have only mild symptoms.

In many cases of salpingitis, especially in mature women, symptoms of the initial infection of the external genitals may be entirely lacking, so that it is often impossible to tell the duration of the disease. In young women gonorrhea pursues a more typical course than it does in mature women on account of the greater delicacy and susceptibility of the tissues. Such a course would be somewhat as follows: Two or three days after exposure by coitus the patient notices a burning on micturition. This burning usually lasts only a few days, but may last much longer. A purulent discharge is soon noticed, and the patient passes through an attack of urethritis of greater or less severity. If the attack of urethritis is a mild one, as is more often the case, the patient will remember only that she had a period of smarting urination associated with a leukorrheal discharge. If Skene's glands are involved, the urethritis symptoms will be more marked. After the subsidence of the urethral symptoms the patient is troubled with a leukorrheal discharge the severity of which depends on the care which she receives. In the course of two or three weeks or more (sometimes less) one of the vulvovaginal glands may become involved and an abscess develop which is very painful and brings the patient under a doctor's care. The doctor treats the abscess by poultices or incision and the abscess subsides for the time being, only to appear again at some indefinite period in the future. The leukorrheal discharge continues, but changes somewhat in character. It loses its creamy purulent appearance and becomes more stringy and mucous, representing now the discharge from an infected endocervix. The change in character is due to the mixture of mucus which pours forth from the overstimulated endo-

cervical glands. Gonococci become more difficult to find in the discharge, and many successive examinations, even when taken from the endocervix, may be negative, a point to be remembered when one is trying to determine whether or not a patient is still capable of transmitting the disease. In the course of an indefinite period of time (days, weeks, months, or years) the patient is seized with an attack of acute abdominal pain, with great tenderness across the lower part of the abdomen. There is moderate fever, usually vomiting and constipation. The pain is usually general across the lower abdomen, but it may be localized on one side. The patient is compelled to go to bed and summon medical help. At the present day the general practitioner recognizes and properly diagnoses these cases better than was done a comparatively few years ago. If the pain was localized chiefly on the right the patient was frequently hurried to a hospital, where her appendix was removed through a McBurney incision, the true cause of the disease not being even then discovered. These attacks are commonly called by the laity "inflammation of the bowels."

The duration of an attack of acute salpingitis is usually from one to six weeks, and is longer than the average attack of appendicitis. This fact is valuable as a guide in interpreting the history of a patient who describes a past abdominal attack. If she had a right-sided attack, from which she was confined to her bed less than a week, she may have had either appendicitis or salpingitis, the evidence being rather in favor of the former. If, however, she was confined to her bed for several weeks the preponderant evidence is very much in favor of a salpingitis.

Acute salpingitis is not often fatal, especially if it is the first attack and tends gradually to subside. It may even heal spontaneously and completely, but this does not happen often. The usual course is that after the cessation of the acute symptoms the disease becomes chronic, lighting up at occasional intervals into an acute activity of greater or less severity.

Rupture of a pyosalpinx is a rare accident. Lamoureux, in 1912, was able to collect only 27 authentic cases in the literature. The onset of symptoms is sudden. It is said that sometimes the patient is conscious of the rupture of the sac. Pain ensues, at first localized to the pelvis and then spreading to the entire abdomen. All the symptoms and signs of general peritonitis follow. Diagnosis is difficult, the condition usually being regarded as a peritonitis from an appendicitis, unless the attending physician has been familiar with the case preceding the rupture. Prognosis in these cases is fairly good as compared with general peritonitis from other causes, the mortality being about 50 per cent. in cases that receive early operative treatment.

Probably the most common form of acute gonorrheal salpingitis is that which represents an acute exacerbation of a chronic process. It does not necessarily mean that there has been a previous acute attack, because, as we shall see later, salpingitis may start and continue for some time without acute symptoms. Acute secondary salpingitis is apt to be more severe and more destructive than a primary attack. This is due to the fact that the preceding chronic proc-

ess has been causing slow damage to the pelvic organs, which have become permanently dislocated and distorted by adhesions. Thus, a tube which has become adherent to an ovary is more likely to impart a destroying inflammation to the ovary than in a fresh case where the organs are normally separated. Or, again, if the bowel be attached to the tube an acute salpingitis is liable to cause such damage to the wall of the gut as to allow organisms to pass through from the intestinal canal and take part as a mixed infection in the pelvic inflammatory process. This mixed infection increases very much the danger of a fatal peritonitis. On account of the confining adhesions in secondary salpingitis it may readily be seen that there is a greater tendency to the formation of large abscess than in the first type. In the latter case the active period of the disease is apt to subside before the tubal ends become sealed. In the secondary type the pus becomes confined at once by unyielding adhesions already formed, and thus is produced more commonly the large tubal or tubo-ovarian abscesses.

The symptoms and course of a secondary acute salpingitis are very similar to those in a fresh case. There is usually to be had in the secondary form a history of previous similar attacks or of a chronic pelvic inflammation. In this type of salpingitis, as in the first, the tendency of the disease is to subside under proper treatment, but the abscesses often become so threatening that operative measures have to be taken early.

**Diagnosis of Acute Salpingitis.**—There are two distinguishing features which characterize all cases of acute salpingitis, and if these be borne in mind the diagnosis is comparatively simple. One is the condition of the abdomen, as shown by palpation, and one is the condition of the sides of the pelvis, revealed by bimanual examination. The abdomen is very characteristic. The area just above the pubes, such as can be covered by the whole hand laid transversely, is uniformly tender and rigid, while the abdomen above the umbilicus, except in extreme cases, is markedly less tender and less rigid. The area of tenderness and rigidity in the lower abdomen of course corresponds to the well-defined limits of local peritonitis which characterizes the disease. Vaginal examination usually reveals tender masses in the sides and back of the pelvis, in which case the diagnosis is practically obvious. Sometimes, however, definite masses cannot be felt, and then one makes a diagnosis from a well-defined *tenderness* of the adnexa which is almost pathognomonic. Real tenderness must be carefully differentiated from that caused by inexpert or ungentle vaginal touch.

In making a diagnosis the patient's history, general appearance, and social condition are of importance, but often misleading. Careful inspection of the external genitals is of great value. The presence of an intact hymen in a doubtful case makes salpingitis improbable, but does not entirely rule it out, in young women. Gonorrheal stigmata, such as a urethritis, inflammation of Skene's and Bartholin's glands, throw the weight of evidence in favor of salpingitis, as does also the presence of gonococci in a vaginal discharge. If evidence of external gonorrhea is absent, it must be remembered that in a first salpingitis attack

the external infection may have been very mild or quite temporary, or the primary seat of infection may have been in the endocervix. In secondary salpingitis the external signs of gonorrhea have usually disappeared long before.

In making a diagnosis of salpingitis the complement-fixation test is sometimes useful. It is very similar in principle to the Wassermann reaction for syphilis. By those thoroughly familiar with the test it is regarded as a valuable adjunct in the diagnosis of gonorrhea. The test cannot be used in early acute cases, for it is negative until the third or fourth week after the disease is contracted. According to Norris, in subacute or chronic gonorrheas the percentage of positive results is about as high as those afforded by the Wassermann test for syphilis.

**Differential Diagnosis of Acute Salpingitis.**—The conditions most likely to be confused with acute salpingitis are appendicitis, extra-uterine pregnancy, twisted pedicle cyst, infected or twisted fibroids, and diverticulitis of the sigmoid.

Appendicitis can usually be readily distinguished from salpingitis by the location of the pain and the area of abdominal tenderness, which in the adult is approximately 3 inches higher than the site in which tubal symptoms usually appear. The pain of appendicitis is apt to start in the epigastrium before becoming localized in the right side, while that of salpingitis usually begins in the pelvic region. This difference is, however, not entirely reliable, for the pain of salpingitis is frequently felt first in the midabdominal region. If the inflammation of the appendix extends to and includes the tube, as it often does in young girls, the location of the initial pain causes confusion. In salpingitis the local symptoms are usually on both sides of the abdomen, though they may be more intense on either side. If they are confined to the left side, appendicitis is unlikely, but is not necessarily ruled out. Palpation of the abdomen in most cases gives definite information. In localized appendicitis the right rectus muscle shows involuntary rigidity, which is either absent or less marked in the left muscle, and the rigidity is most evident at McBurney's point, especially if there is present also an inflammatory exudate. On the other hand, localized salpingitis causes an even symmetric rigidity of the lower portions of both muscles below the umbilicus, though one side may be more tender than the other.

Bimanual examination gives by far the most important information in the differential diagnosis, and should never be omitted as a routine, even if the case seems to be unquestionably one of appendicitis. In uncomplicated appendicitis the vaginal finger elicits no pelvic tenderness, while in acute salpingitis pelvic tenderness is always present and is very characteristic. In the majority of cases distinctive masses may be felt in the adnexa. If the hymen is unruptured the evidence is against salpingitis, but does not exclude it, for the gonococcus can gain access to the tubes from the vulva. Gonorrheal stigmata, such as pus from the urethra, inflammation of Skene's and Bartholin's glands, favor the diagnosis of salpingitis. An intact hymen often necessitates a bimanual examination per rectum. In making a rectal examination it must always be

borne in mind that the uterus and cervix feel much larger than when examined through the vagina.

If appendicitis has implicated the right tube, the diagnosis is more difficult, but even in this case the pelvic tenderness is much higher up than in a typical case of uncomplicated salpingitis.

The onset of the attack and its course for the first few days is quite similar in the two diseases, but appendicitis tends either to become rapidly worse, with symptoms of peritoneal extension, or it subsides in a few days. Salpingitis, on the other hand, has little tendency to general peritonitis, but local symptoms of an acute attack extend over a considerably longer period.

If general peritonitis is present the diagnosis is very much in favor of appendicitis. A salpingitis severe enough to cause general peritonitis would almost invariably show unmistakable evidence of adnexal enlargement.

Between acute salpingitis and extra-uterine pregnancy there should, as a rule, be no great difficulty in diagnosis. The pain of extra-uterine is sharper and more lancinating than that of salpingitis and is less constant. Abdominal rigidity and tenderness is less marked than in salpingitis and may be absent altogether. By vaginal examination the pelvis may feel the same in the two conditions as regards adnexal enlargement, but in salpingitis there is much greater tenderness as a rule. A purulent vaginal discharge or the stigmata of gonorrhea favor salpingitis.

In salpingitis the constitutional symptoms are more severe and the leukocytosis is much more significant.

In ectopic the usual history of a delayed period is a very important, though not absolutely reliable, sign.

Between chronic salpingitis and a pelvic hematocele from ectopic the diagnosis is very difficult, as is pointed out in the chapter on Extra-uterine Pregnancy.

The symptoms of a twisted pedicle cyst may be very like those of a salpingitis, and, as there is often an acute inflammatory process added to the condition of torsion, the differential diagnosis may be very baffling. The diagnosis is of vital importance because torsion of a cyst demands immediate operation, while in acute salpingitis operation is usually to be deferred.

The history of the case is very valuable, though in both diseases there may be an account of recurring attacks. Bimanual examination in the early stages of torsion shows tenderness and a mass only on one side unless there happen to be bilateral cysts. At this stage, too, the cyst is movable and distinguishable from the immobile mass of a salpingitis. If torsion has resulted in infection and peritonitis, a differential diagnosis may be impossible, but patients who have reached this stage are very sick and operative interference is palpably urgent. In case of doubt it is always best to operate, for, if torsion is present, the life of the patient may be saved, while, if the disease is salpingitis, operation ordinarily does no harm and may even hasten the convalescence.

What has been said of torsion and infection of cysts may be said also of pedunculated fibroids.

Diverticulitis of the sigmoid may cause symptoms and present signs very like acute salpingitis. It may more closely resemble tubal inflammation than appendicitis, for, on account of the mobility and length of the sigmoid, the inflammatory mass in which the diverticulum is involved may lie deep in the pelvis, so that it cannot be distinguished by touch from an adnexal enlargement. Diverticulitis is confined to the left side and occurs usually in women beyond the age in which a salpingitis is liable to be contracted. The first case of diverticulitis seen by the writer was diagnosed by him as a pyosalpinx.

**Treatment of Acute Salpingitis.**—This is usually expectant if there is no doubt about the diagnosis. It consists in complete rest in bed, with frequent hot vaginal douches and hot applications to the abdomen for the relief of pain. As the peritonitis is limited to the pelvis and has little tendency to become general, it is best to keep the bowels open by catharsis and enemata. The leukocyte count of the blood, taken every two or three days, is an excellent guide to the progress or subsidence of the disease. Most cases of acute salpingitis subside partially or completely under proper care and nursing.

The decision as to later operative methods is determined by various factors. If the attack of salpingitis is the first one, and subsides, leaving little evidence of the disease by bimanual examination, it is best not to operate, but to keep the patient under observation, for the disease may possibly heal spontaneously. Patients whose abdomens are opened under these conditions often show nothing abnormal in the appearance of their pelvic organs, even though later they may start up a destructive pelvic inflammation. It is best, therefore, to wait and see whether other acute attacks ensue, or whether the organs are to undergo a slow process of chronic adherent inflammatory disease, or whether, perchance, the patient may not get well spontaneously. If a first attack of salpingitis simulates closely an appendicitis or a twisted pedicle cyst or an extra-uterine pregnancy, and there is much doubt in the mind of the attending surgeon, it is better to operate at once, for with the last-named conditions an operation is usually imperative, while if the case does turn out to be one of salpingitis a properly performed operation does little harm and may hasten the convalescence.[1] If the attack of salpingitis leaves permanently damaged organs, the case comes under the heading of chronic pelvic inflammation, to be discussed later.

If a secondary acute salpingitis appears, the treatment is still expectant, but somewhat less conservative than in the case of a primary salpingitis. Here the damage to the organs is usually more obvious, and, as a rule, operation is de-

[1] The frequent success that attends early operation on cases of acute salpingitis has led many surgeons to adopt early and radical operative treatment as a routine. For an excellent discussion of the subject the reader is referred to an article by Dr. F. G. Dubose (Surg., Gyn., and Obst., September, 1921). In the hands of an expert operator there is no doubt that the radical method has great merit. It is quite probable that the surgeon who operates early and radically, though he may occasionally mutilate a patient who might have recovered spontaneously, will in the end effect a greater number of cures than he who follows the more conservative course.

ferred only until the more acute symptoms subside. In the average case this requires from ten days to three weeks. Sometimes the symptoms do not subside and an operation must be done to save the patient's life. This is eminently so when there is a large pelvic abscess whose course suggests a mixed infection. These abscesses may occur in the primary attacks, but are more apt to appear in the secondary cases, as described above. Inasmuch as the tubes are drawn downward and backward by the inflammatory adhesions, the abscesses are consequently found, as a rule, deep in the posterior culdesac. As they increase they tend to point downward into the vagina, and may be readily punctured from an incision through the posterior wall of the vagina. This operation should not be used as a routine, but may be resorted to in extreme cases. As a rule, the operation of vaginal puncture is not necessary. The patient may be kept under treatment of rest and hot douches until the temperature and leukocytosis become normal. The patient is then ready for operation, the nature of which depends on the extent of damage to the pelvic organs. In the severely destructive cases it is necessary to remove the adnexa and uterus by a supravaginal hysterectomy with drainage through the vagina. (See page 761.)

### Chronic Pelvic Inflammation as a Result of Gonorrheal Salpingitis

Chronic pelvic inflammation is a disease which is of the greatest clinical importance, both to the specialist in gynecology and to the general practitioner, for not only is it of very wide occurrence, but its general constitutional results are varied and far reaching. We have seen in the remarks on the pathology of salpingitis that the chronic stage consists in a gradual process of pelvic adhesions which dislocate and immobilize the genital organs. The symptoms of chronic pelvic inflammation are due directly or indirectly to this adhesive process. The chronic form of the disease may ensue after an acute attack, or it may develop gradually without a definite initial onset. This is due to the fact that the first infection may run a very mild course, so as to attract little attention on the part of the patient. The resulting adhesive process may, however, be considerable and quite incommensurate with the mildness of the beginning of the disease. It is even possible for a patient to have an extensive chronic pelvic inflammation without any subjective symptoms at all, the condition being found incidentally during an operation for some other cause. Usually, however, the symptoms are fairly definite and quite characteristic. The most constant is pain in the lower abdomen on one or both sides. This pain is either continuous or frequent, with short intermissions. It is made worse by exertion. The pain is usually not very severe in character, but is described as dull and dragging. Sometimes it is little more than a continuous pelvic discomfort which the patient has difficulty in describing. The seat of the pain is always low in the abdomen; on the right it is 2 or 3 inches below McBurney's point. Allied symptoms are very numerous and represent disturbances of most of the functions of the body.

Patients with chronic pelvic inflammation look worn and dragged. Girls lose the bloom of youth and appear prematurely old. The continuous nagging pain of the pelvis acts as a severe irritant to the nervous system, so that these patients usually become neurotic, irritable, introspective, melancholy, often hysteric. Digestive disturbances are common. On account of the adhesions of the large intestine constipation and mucous colitis are frequent. The disturbance of the nervous and digestive functions leads to headaches. Adherent masses in the posterior culdesac, or the backward dislocation of the uterus, may cause sacral backache. Most women with this disease are sterile, and this may be a source of mental worry. Leukorrhea from an associated endocervici-

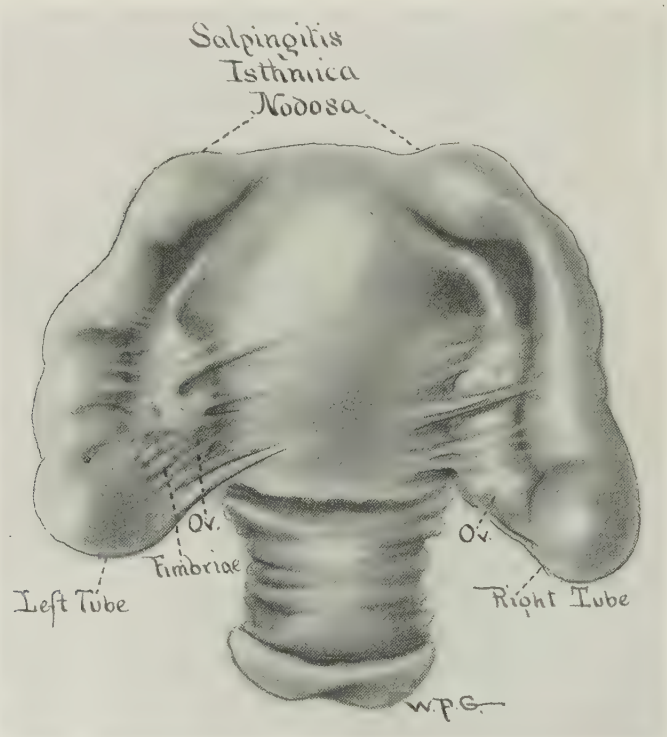


Fig. 45.—Chronic Salpingitis.
Both tubes are closed and implicated in adhesions. Salpingitis isthmica nodosa is seen at the bases of both tubes.

tis is usually present and aggravates the nervous and mental distress. Bladder symptoms are sometimes present, but are not common, because the disease does not usually extend to the anterior half of the pelvis.

Disturbances of menstruation are common and are of importance. Some of the menstrual abnormalities of chronic pelvic inflammation cannot easily be explained. Some think them due to a disturbance in the ovarian secretion, which is believed to preside over the function of menstruation. This, however, is not proved. There is usually dysmenorrhea, in the sense that the pelvic pains are

exaggerated during catamenia. As will be seen (see page 549), this must be regarded not as an essential, but as a secondary, dysmenorrhea. It is doubtless due to the increased congestion of adherent and immobilized organs.

It occasionally happens that there is a temporary amenorrhea. Patients in this condition sometimes think themselves pregnant and attempt abortion, with very disastrous results.

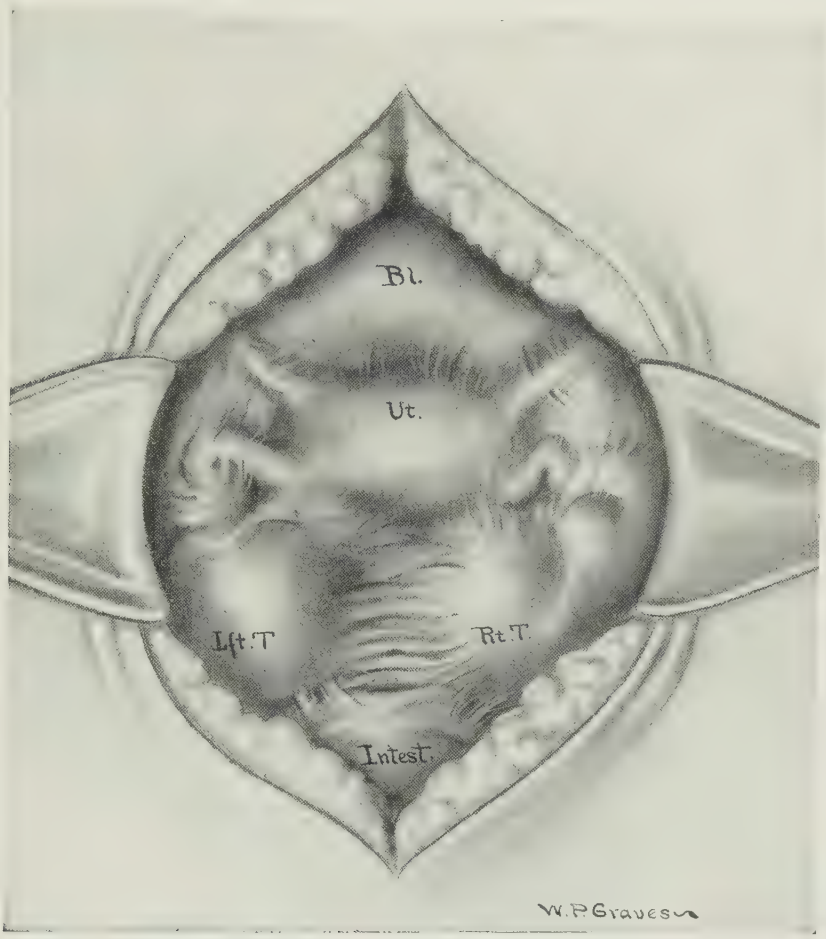


Fig. 46.—Pelvic Adhesions from Salpingitis.
Seen through an incision with the patient in the Trendelenburg position. Bladder, uterus, tubes, and intestines are all involved and matted together in a mass of adhesions.

Menorrhagia and metrorrhagia are not uncommon, and may lead to much confusion in diagnosis. For example, a period of menorrhagia may follow a period of amenorrhea. This sequence, in connection with pelvic pain and a palpable mass, may cause a very excusable diagnosis of extra-uterine pregnancy. The abnormal uterine bleeding sometimes leads the attending physician to curet the uterus, a dangerous procedure, which too often results in lighting up the chronic process into dangerous activity

A rare appearance in this disease, but one which causes great apprehension on the part of the patient, is a sudden gush of a large amount of water or pus from the vagina. This may occur periodically, and is due to the sudden emptying backward of a tubal cyst or a tubal abscess. This condition is called *hydrosalpinx* or *pyosalpinx profluens*. As we have seen, the isthmus of the tube ordinarily prevents any backward flow of fluids, but it appears that occasionally its valve-like action is incompetent, and the pent-up serum of a hydrosalpinx or the pus of a pyosalpinx may discharge into the uterine canal and vagina. If this occurs only when the fluid contents exert a certain pressure the discharge may act automatically and become periodic.

**Treatment of Chronic Pelvic Inflammation.**—The treatment of chronic pelvic inflammation is either medical or surgical. Medical treatment consists in local applications to the vagina designed to allay the inflammatory process, while surgical treatment consists in the removal of organs or parts of organs that are permanently damaged.

The time-honored *medical treatment* is the use of hot vaginal douches and the application of iodin and tampons to the vault of the vagina. We have already seen that hot douches are valuable in helping to reduce inflammation in the more active stages of the disease. They are also valuable for relieving the pain and congestion when the disease is chronic. Iodin acts as a counterirritant and vaginal antiseptic, while the effect of tampons soaked in glycerin and ichthyol is somewhat similar to that of a poultice. By these means patients can often be temporarily relieved of their symptoms, but applications to the vagina have no permanent effect on the pelvic adhesions, so that local treatment cannot be regarded as a curative measure. In some cases, however, douches and tampons relieve the patient to such an extent that more radical treatment is unnecessary. The majority of these patients come sooner or later to operation.

Chronic pelvic inflammation with adhesions is sometimes treated by the electric application of heat, the treatment being known as *diathermy*. It is contraindicated in the presence of pus or hemorrhage. Direct-high frequency electric currents are applied to the pelvic organs by placing large electrodes one on the abdomen and the other either on the lumbosacral region or in the vagina. The heat is developed slowly and progressively and is continued thirty to forty minutes. It is claimed that by this method pain is relieved and the organs become freely movable, due to an "absorption of the adhesions." Excellent results have been reported by Kowarschik, Keitler, and Recasens. Considering the relief given in chronic pelvic inflammation from the time-honored use of hot douches the treatment seems logical, but it is doubtful if an actual absorption of adhesions takes place.

The *surgical treatment* of chronic pelvic inflammation is either conservative or radical, depending on various factors, such as the amount of destruction of the tissues, the age of the patient, her social condition, etc. Conservative surgery of chronic pelvic inflammatory disease consists in saving as much of the pelvic organs as possible. This is often feasible because there may, for example, be irreparable damage to one tube, while the other may have healed completely, or one ovary may be extensively involved in an adhesive or cystic

process, while the other may have escaped serious injury, or one portion of a tube may be comparatively sound, while the rest of it is beyond repair. Thus, various problems present themselves which must be solved by the ingenuity and experience of the operator. The various combinations and devices for conservative operations on the adnexa are described in detail on pages 805–814.

When the organs are damaged to such an extent that conservatism offers no hope for a cure, it becomes necessary to do a radical operation, which consists in the removal of the uterus and appendages by a supravaginal hysterectomy. The decision as to conservatism or radicalism requires on the part of the surgeon a wise judgment based on experience, a knowledge of pathology, and correct information of the patient's clinical history, social condition, and personal wishes regarding the disposition of her pelvic organs. Surgeons differ considerably in their ideas as to when to be conservative and when not to be. Moreover, each case must be decided on its individual merits. Hence, it is impossible to lay down an entirely satisfactory code of rules that will meet the requirements of every case. There are certain general principles which may serve as valuable guides in the conduct of these cases, but the final decision must rest chiefly on the judgment of the operator.

In the first place, it must be recognized that the final clinical and pathologic results of conservative operations are not as good in the percentage of cures as are those of properly performed radical operations. This is due to the fact that postoperative adhesions are much more apt to form after conservatism. It is impossible in most cases to perform such operations as salpingectomy, salpingo-oöphorectomy, salpingostomy, resection of the ovary, etc., without leaving surfaces which are more than likely to become adherent. The peritoneal wounds, even with the greatest care, are somewhat ragged, and it is inevitable that a considerable number of catgut knots and sutures must be left exposed to act as irritants to the peritoneum. In addition to this, much of the pelvic peritoneum which has been damaged by the breaking up of adhesions is necessarily left in a condition favorable to the re-formation of adhesions. This is especially true of the posterior wall of the uterus and the posterior leaves of the broad ligaments. The same is true of the damaged surface epithelium of the ovaries.

In the radical operation of supravaginal hysterectomy, on the other hand, if it is performed as described on page 761, there is no exposure of damaged peritoneal surfaces except in the deepest parts of the pouch of Douglas, where it does practically no harm. The pelvic peritoneum which comes in contact with the overlying intestines and omentum after the operation is only that of the anterior half of the pelvis, in which, we have seen, adhesive peritonitis does not usually take place, and the peritoneum is, therefore, left smooth and uninjured. In addition to this, only one catgut knot is exposed, and that is in a position where it does little harm.

There is, therefore, a great difference in the results of the two operations as far as the formation of postoperative adhesions is concerned, and, in consequence, there is necessarily a difference in the clinical results. A conservative operation

nearly always relieves the patient partially or completely for a time, but many of the patients in the course of a period of time varying from a few months to one or two years begin to experience again the old nagging pains, and a certain number of cases come again to operation. The recurrence of the symptoms is due to the slow re-formation and contraction of pelvic adhesions and a repetition of dislocating and immobilizing of the organs. However, many patients get entirely well, and the percentage of cures is sufficiently greater than that of failures to make the operation advisable under certain conditions.

Although the radical operation when properly done has a higher rate of symptomatic cures than has the conservative, there are objections to the removal of the pelvic organs which must be carefully considered. First, there is the prevalent idea that such an operation is usually followed by certain serious and definite nervous symptoms. This subject is discussed in the section on Neurology, and we see there that this wide-spread belief dates from the time when hysterectomies were performed in such a way as to result in pelvic adhesions and prolapse, two conditions *which are the chief causes of genital neuroses.* The objection is not a serious one at the present day.

In young women, whether married or unmarried, it is obvious that the radical operation should not be performed unless the organs are so irreparably damaged that conservatism is no longer feasible. The reasons for conservatism in young women are partly sentimental and social, but these are so powerful that conservative operations must be performed even when there is a considerable prospect of a later operation. In addition to this is the moderate percentage of possibility of making the patient fecund. (See section on Sterility.)

The question of the change of sexual feelings after castration is discussed on page 130.

The personal environment of the patient is a factor of the greatest importance, and one with which the surgeon should be thoroughly familiar before undertaking an operation for pelvic inflammation. For example, in the case of a poor widow who has living children depending on her for care and support a radical operation, with its greater likelihood of a permanent cure, might be advisable, whereas in a recently married woman of the same age it might be unjustifiable. In women approaching or past the menopause the radical operation is preferable unless the destructive process is comparatively slight. When one or more conservative operations have been performed without relief to the patient the radical operation is obviously indicated.

In a large number of cases the problem is solved at once by the fact that the organs are beyond reasonable hope of repair. A radical operation is then imperative, irrespective of age or condition. Sometimes this condition presents itself unexpectedly, as the preliminary bimanual examination may fail to reveal the real extent of the pathologic process. In such a case the surgeon may be in an embarrassing predicament if he has failed to gain the consent of the patient for the removal of organs. It is, therefore, of the greatest importance that before every pelvic operation where inflammation is suspected the situation

be explained to the patient, and her consent, and, if she be married, that of her husband, be secured for the performance of whatever operation the surgeon considers for her best health and welfare.

### SERUM AND VACCINES IN GONORRHEA

The treatment of gonorrheal conditions by serum and vaccines has been only partially successful. In gynecologic practice it may be said that with our present knowledge neither of these forms of treatment are of use in cases of acute urethritis or in pelvic inflammatory conditions, whether acute or chronic. The best results have been obtained in gonorrheal arthritis and in the vulvovaginitis of children. In the latter disease the benefits from the use of vaccines is so well established that it should always be adopted as a specific part of the treatment.

Antigonococcic serum is usually prepared from healthy rams that have been treated with gradually increasing doses of dead and live cultures of gonococci. The dosage is 2 c.c. of the serum, administered subcutaneously for from two to five doses, with intervals of one to five days, according to the reaction produced in the patient and the behavior of the disease. The reaction in the patient shows a slight elevation of temperature and a feeling of malaise. There is some redness and swelling about the point of injection. A slight increase in the discharge from the genital tract is produced for the first few days following treatment (Norris).

Vaccines are preparations of dead gonococci suspended in normal salt solution and standardized, so that the number of gonococci to a cubic centimeter of the salt solution is known. Autogenous and stock vaccines are used; autogenous vaccines are preparations of dead gonococci that have been obtained from the patient and grown on culture-media. Stock vaccines are obtained from several cultures that have been taken from as many different individuals, usually about eight or ten different strains being used. The autogenous are regarded as somewhat more efficacious than the stock preparations. The stock vaccines are put up in sealed containers, each container holding a known number of dead bacteria. The vaccines are administered subcutaneously, four or five doses being the average treatment. The dosage begins with about 5,000,000 bacteria, and is increased up to 20,000,000 or more. The reaction is similar to that from the serum. The opsonic index is a valuable guide to the dosage, but is rarely available (Norris).

The reaction induced by the injection of dead gonococci has been used as a sign of the presence of gonorrheal disease. Its value in practical diagnosis has not yet been established.

Wolff has reported excellent results in the use of vaccines in 40 cases of vulvovaginitis. He strongly urges the advantage of autogenous vaccines, and recommends that no other treatment be given except that of ordinary cleanliness. The vaccine is injected hypodermically, the initial dose being 25,000,000 to 50,000,000. The injections are given at intervals of five to seven days over a period of about thirty-five days.

## GENITAL TUBERCULOSIS

Tuberculosis of the female genital organs is confined chiefly to the tubes and endometrium. It may, however, appear exceptionally as an affection of the vulva, vagina, or cervix. In the study of this subject there have been established certain facts with which it is important to be familiar:

(1) It has been shown by experiments on susceptible animals that pure cultures of tubercle bacilli when deposited on the surface of the vagina will rarely grow unless there has been a previous lesion of the epithelium. If, however, the cultures be deposited in the horn of the uterus the result is practically always positive.

(2) Although tubercle bacilli have been demonstrated by experimentation in the semen of males affected by pulmonary tuberculosis, it is doubtful if the disease is ever transmitted by coitus.

(3) The question of heredity is an important one. It has been shown that the mother may infect the fetus from a distant focus through the blood circulation. It has also been shown that the fetus and placenta may be infected by coitus. Infections of this kind must be regarded as incidental and unusual. The inheritance from tubercular parents is more commonly a predisposition to the disease, in the form of a weakness on the part of certain epithelial structures in resisting the invasion of the tubercle bacillus.

(4) Genital tuberculosis in women is quite independent of the urinary tract and does not tend to ascend from the former to the latter.

(5) It is thought that genital tuberculosis may ascend in the genital tract—*e. g.*, from the cervix to the endometrium, and thence to the tubes—but this must be very rare. There is, however, a decided tendency of the disease to *descend* from the tubes to the endometrium.

### TUBERCULAR SALPINGITIS

Tuberculosis attacks both the mucous membrane lining of the tube (endosalpinx) and the peritoneal covering (perisalpinx). The tube is an especially favorable location for the growth of the tubercle bacillus as well as for the gonococcus, on account of its convoluted form and its succulent lining membrane.

Tuberculosis of the tubes, whether of the endosalpinx or the perisalpinx, is always bilateral. It is doubtful if the infection ever takes place primarily in the tubes, the mode of infection being either ascending or descending, or by the hematogenous route from some distant focus.

Ascending infection from a tuberculosis of some part of the external genitals is exceedingly rare, and there is reasonable doubt if it ever occurs. In this respect the progress of the disease is in marked contrast to that of gonorrhea.

Descending infection originates from a tuberculosis of the peritoneum or intestines above the tubes. The descending disease may affect either the perisalpinx or the endosalpinx, or both. When only the perisalpinx is involved, the surface of the tube merely takes part in a general tubercular pelvic peritonitis. When the endosalpinx is involved the disease becomes specialized.

The hematogenous mode of infection in the tubes implies a metastatic growth of tubercle bacilli which have come by the blood circulation from some distant focus, usually in the lungs. In this case the original focus may become entirely healed, while the new growth of bacteria may continue to flourish. The infection may, therefore, appear to be primary in the tubes, whereas it is, in reality, secondary.

Except when the tubes take part in an acute general miliary tuberculosis, tubercular salpingitis is always chronic. As we have seen, the disease may be either an endosalpingitis or a perisalpingitis, or both.

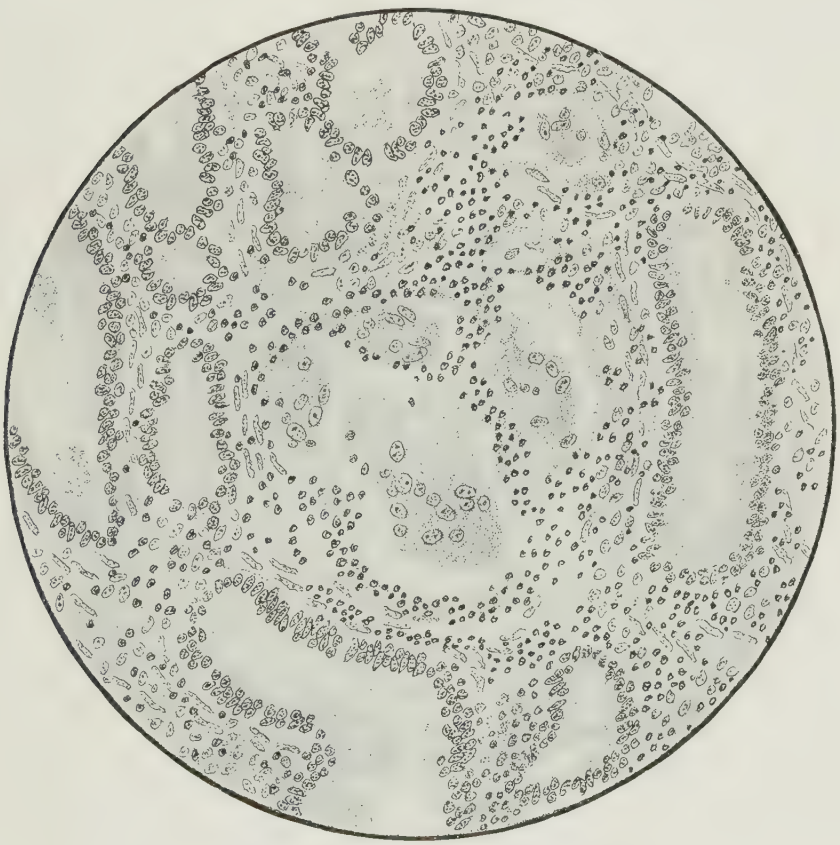

FIG. 47.—TUBERCULAR SALPINGITIS.

High power to show giant-cells. The gland-like spaces are follicles formed by fusion of the villi. In the center of the drawing are four giant-cells which are characteristic of tuberculosis. The tissue around them has become necrotic and is infiltrated with round cells, mostly of the mononuclear variety.

Tubercular endosalpingitis somewhat resembles in its processes a gonorrheal infection. The first stage is catarrhal, in that it involves only a superficial inflammation of the mucous lining. The tubal ostium tends to close early and the disease may progress to a tubercular pyosalpinx. The contents of a tubercular pus-tube consist of a white, mushy, cheesy material if the infection is exclusively tubercular, but a mixed infection in these tubes is common. If the latter takes

place the pus-tube is then exactly like that originating from gonorrhea. In fact, tuberculosis and gonorrhea may exist together. In pus tubes of this kind the presence of the tubercle bacillus may sometimes be detected by miliary tubercles on the surface of the tubes. Often it is only discovered by microscopic examination of the walls of the infected tube. This similarity that exists between large tubercular and gonorrheal pus-tubes may in some circumstances be of serious domestic or medicolegal importance. The later pathologic processes of a tubercular tube are quite different from those of gonorrhea. An old tubercular tube, in which the more active process has ceased, is usually either caseous or fibrous, each of which conditions is entirely characteristic. In the former case the enlarged tube contains a white homogeneous cheesy mass which is unmistakable, while in the second case a fibrosis takes place which completely occludes the lumen and leaves the tube a solid fibrous cylinder. A third form of end-result is a hydrosalpinx, though this is not common. There is no doubt that genital tuberculosis may exist in fetal life. It is thought that the rare cases of so-called congenital hydrosalpinx are the outcome of a fetal tubercular salpingitis (Anspach).

Tubercular perisalpingitis is manifested by the appearance of miliary tubercles on the peritoneal surface of the tubes. This may exist by itself, or as a part of a tubercular peritonitis. It is evident that a tuberculosis of the perisalpinx may extend through the ostium of the tubes to the endosalpinx, and, conversely, tuberculosis of the endosalpinx may extend to the perisalpinx, either through the ostium or by direct extension through the tubal wall.

Tubercular salpingitis is nearly always associated with pelvic adhesions, which in a severe case may be of extraordinary density and strength, so that the adherent mass is absolutely inextricable. This is in contrast to gonorrheal adhesions of the pelvis, which are rarely inoperable.

The **symptoms** of tubercular salpingitis unassociated with a tubercular peritonitis are the same as those of chronic gonorrheal salpingitis. The condition found by pelvic examination is also exactly the same, so that, unless there is an intact hymen, it is almost impossible to make a definite diagnosis of tubercular salpingitis. The presence of a tubercular focus elsewhere in the body may serve as a guide to the diagnosis, but it is as often misleading. If genital tuberculosis is associated with a general tubercular peritonitis the diagnosis may then be very obvious.

The **progress** of tubercular salpingitis is very slow and insidious. If it comes on early in life it may cause a local or general hypoplasia or underdevelopment of the individual. Amenorrhea is sometimes a result of the disease, especially if it has extended to the endometrium, while sterility is almost inevitable.

The **treatment** of tubercular salpingitis is practically the same as that of chronic pelvic inflammation from gonorrhea, except that in young women the operation should tend more to the radical operation of hysterectomy. This is due partly to the fact that conservative operations are apt to be followed by a

recurrence of symptoms, and partly to the fact that the endometrium is secondarily involved in a large percentage of cases.

Some cases, where the pelvis is filled with a densely adherent mass involving the intestines, are entirely inoperable, but these inoperable cases may make extraordinary cures under proper hygienic treatment, due to the fact that chronic adhesions, unlike those from gonorrhea, often become completely absorbed and disappear spontaneously.

As has been shown, the diagnosis of tubercular salpingitis is nearly always made after the abdomen has been opened.

Old shrivelled up fibrous tubercular tubes found incidentally during pelvic operations may be removed without disturbing other organs.

### TUBERCULOSIS OF THE UTERUS

Tuberculosis of the uterus is usually confined to the endometrium, and this, in turn, is usually associated with and secondary to tuberculosis of the tubes.

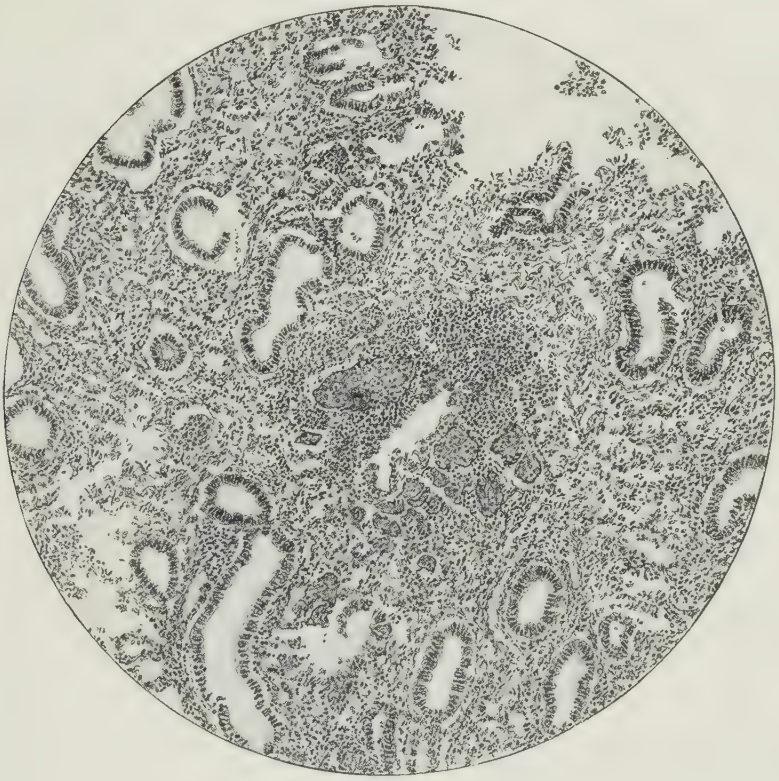

FIG. 48.—TUBERCULAR ENDOMETRITIS.

Low power. Around the edges are dilated glands lying in an edematous stroma. The center contains a tubercle consisting of necrotic tissue infiltrated with round cells and containing several giant-cells.

The infection takes place by descending extension in the manner mentioned above. It is difficult to say how frequently tubercular endometritis complicates

tuberculosis of the tubes, but good authority estimates it as occurring in about one-half of the cases (Küstner). This is a matter of considerable practical importance in deciding the question of a conservative or radical procedure when operating on the tubes. *Tuberculosis of the endometrium*, as a rule, usually affects only the mucous membrane, and usually appears microscopically only as scattered tubercles in the stroma. It may, however, become more extensive and ulcerate the surface. Rarely the process invades the myometrium, and may even go so far as to convert the uterus into a cheesy, necrotic mass.

FIG. 49.—TUBERCULOSIS OF MYOMETRIUM.

Tubercular endometritis is not a well-defined disease by itself, and is usually discovered only incidentally during a microscopic examination of uterine curetings. When symptoms occur, the most common is persistent leukorrhea. If ulceration of the endometrium occurs, there may be bleeding. Sometimes there is long-continued amenorrhea.

Inasmuch as tubercular endometritis is nearly always secondary to tubercular salpingitis, local treatment, such as cureting and antiseptic applications, is futile.

### TUBERCULOSIS OF THE OVARY

The ovaries are not infrequently infected secondarily from a tubercular salpingitis. A few instances of isolated tuberculosis of the ovaries have been reported in which unquestionably the infection must have reached the ovary by the hematogenous route from a distant tubercular focus. Primary tuberculosis of the ovaries, like that of the tubes, is extremely doubtful.

### TUBERCULOSIS OF THE CERVIX

The cervix is rarely infected by tuberculosis, the immunity being doubtless due to the stratified pavement epithelium of the vaginal portion of the cervix, and to the bactericidal action of the endocervical secretion (Menge). According to G. A. Moore, who has made an excellent survey of the literature of the subject, tuberculosis of the cervix may be primary or secondary. As a primary lesion it is exceedingly rare, the source of infection being theoretically from an external source, such as unclean instrumentation or from coitus with a tubercular partner. Secondary infections are more common. They may result indirectly by the hematogenous route from some distant focus, notably the lungs, or they may occur directly as a descending infection from the upper genital tract. Probably the majority of tubercular lesions of the cervix are from the last-named cause. Moore describes a miliary, interstitial, vegetating, and ulcerative type of the disease. Differentiation from syphilis, cancer, or simple erosion can be made accurately only by the microscope. Clinically, cervical tuberculosis closely simulates cancer not only in its appearance, but in its symptomatology. Early primary tuberculosis of the cervix may be treated successfully by amputation or cauterization, but it should be remembered that in the majority of cases it is associated with tubercular disease of the internal genitals. When the disease is extensive or rapidly growing the safest treatment is by total hysterectomy.

L. R. Wharton describes a tuberculous condyloma that resembles carcinoma in appearance. When found it is usually associated with tuberculosis of the endometrium and tubes.

### VAGINA

Isolated tuberculosis of the vagina is a rare disease. When it does occur it is usually found in children. It manifests itself by irregular ulcerations of the vaginal surface.

### VULVA

Tuberculosis of the vulva is the same as lupus, but the term "lupus" should only be applied when the lesion has been proved incontestably to be of a tubercular origin. It appears as extensive ulcerations, combined with polypoid hypertrophy of the tissues. The disease may extend over the perineum to the anus and rectum and may also spread into the vagina. The ulcerations are irregular and covered with a slimy débris. They are sufficiently destructive to cause fistulæ in the labia.

Tuberculosis of the vulva may simulate closely elephantiasis, syphilis, esthiomene, and cancer, and the diagnosis can only be made definitely by microscopic examination of an excised piece of tissue.

The treatment of tuberculosis of the vulva is like that for lupus elsewhere in the body. If the disease has not extended too far into the surrounding tissues a vulvectomy is often advisable.

## TUBERCULAR PERITONITIS

Tubercular peritonitis is not classified strictly as a gynecologic disease, but it is so closely associated with genital tuberculosis, and cases are so frequently seen in gynecologic clinics, that it must be considered here.

Three forms of tubercular peritonitis are to be distinguished:

In the first form miliary tubercles are disseminated over the peritoneum of the abdominal cavity, either generally or partially. There is always ascites, which is usually tinged with blood. Adhesions may or may not be present. This type of the disease is termed *tubercular peritonitis* with *ascites*.

The second form is characterized by extensive adhesions without ascites. The intestines, omentum, and mesentery are matted together in a conglomerate indistinguishable mass. If the pelvis is involved the pelvic organs are implicated in the process. The adhesions are dense and inextricable. It is usually impossible to free intestines bound together in these masses without injuring their walls. Nevertheless, the adhesions seen in this disease, hopeless as they may appear, sometimes entirely disappear at a later stage.

This type is called *dry adhesive tubercular peritonitis*. It may be general or it may be localized in certain parts of the abdomen. The first and second form may occur together in different parts of the same abdomen. In fact, the second type may represent a later stage of the first.

The third form of the disease occurs as tuberculous nodes agglutinated in masses. These masses tend to become necrotic and may cause fistulæ. The tubercular nodes may form circumscribed annular masses around the intestines, with corresponding enlargement of the mesenteric glands, a condition sometimes so closely simulating cancer that it may be impossible to make a diagnosis excepting by the microscopic examination of the tissue. This type is called *nodular tubercular peritonitis*.

The symptoms of tubercular peritonitis vary somewhat, according to the type of the disease. In the first form there may be no well-defined symptoms until sufficient fluid has collected in the abdomen to call attention to the location of the disease. This is the type that is most often seen in the young. General constitutional symptoms are first noticed, such as general weakness, night-sweats, loss of weight and sleep, and various digestive disturbances. Girls are apt to be amenorrheic and to show retarded development. Attention is called to the ascites by enlargement of the abdomen or by dyspnea.

In the second form of the disease the constitutional symptoms are like those in the first. There is apt to be more definite abdominal pain. The adherent

masses may be felt by palpation of the abdomen and resemble various tumor formations. On this account cases of adhesive tubercular peritonitis are frequently encountered during exploratory abdominal operations.

Nodular tubercular peritonitis is clinically a much more serious disease than the other two types. In this form there is greater destruction of tissue; hence, abdominal symptoms may be very severe. Blood and pus may appear in the stools, and the symptomatology, like the gross pathology, may closely resemble cancer of the intestine.

The **diagnosis** of tubercular peritonitis with ascites is usually comparatively easy to make. Ascites in a young person unassociated with heart or kidney disease or edema elsewhere in the body usually means tuberculosis of the peritoneum. If the patient is in the cancerous age it may be difficult to differentiate between tuberculosis and malignant disease. The tuberculin test is useful when there is great doubt.

The diagnosis of adhesive tubercular peritonitis is usually difficult to make with exactness, especially if the conglomerate mass involves the pelvis. These masses are so dense that they are often mistaken for adherent ovarian or fibroid tumors. The condition is especially like the cancerous peritonitis that results from a malignant ovarian cyst. Even after the abdomen is opened it may be impossible to make a diagnosis from gross inspection.

Nodular tubercular peritonitis, as has been mentioned above, is especially like malignant disease, both from external examination and after the abdomen is opened. The diagnosis of tubercular disease from inspection during operation is, of course, simple if miliary tubercles are present, but in the severe cases there is often no sign of them.

The **treatment** of tubercular peritonitis is a subject of interest and speculation. In the ascitic cases the question of operation arises. It was discovered that many of these cases recovered after an operation of opening the abdomen and evacuating the fluid. It was supposed that these cures were due to the effect of letting light and air into the peritoneal cavity. For that reason many surgeons made long incisions and exposed the peritoneum as much as possible. The custom of operating on these cases became general. It was then discovered that many cases got well without operation, and at the present time opinion as to the advisability of surgical interference is somewhat divided. The light and air theory is not now generally held. One theory as to the benefit of opening the abdomen and evacuating the fluid is that the disease is converted by this means into the dry adhesive form, which is a more favorable stage for spontaneous healing. There seems to be no doubt that operation is sometimes advantageous, while the chances of doing harm are almost nil. When the fluid collects to such an extent as to cause dyspnea and other discomforts, evacuation of the fluid may be imperative. This is best done by a laparotomy incision rather than by paracentesis on account of the possibility of adhesions of the intestine to the anterior abdominal wall. If operation is performed the general con-

stitutional measures for treating tubercular patients must, of course, also be carried out.

The dry adhesive form of tubercular peritonitis comes to light usually during an exploratory laparotomy following a doubtful or mistaken diagnosis. If the disease is confined mostly to the pelvis, the case may be operable, and the procedure is that described under Tubercular Salpingitis. If there is considerable involvement of the intestines the case is usually inoperable, as the adhesions cannot be separated without too much bleeding and injury to the intestinal walls. These cases, hopeless as they look, are by no means incurable. Under proper hygienic treatment patients sometimes make the most astonishing recoveries. We have observed 2 cases which came to laparotomy many years after exploratory incisions, when the presence of conglomerate adhesions made further operation out of the question. At the time of the second laparotomy, one of which was for a fibroid and the other for postoperative hernia, the tubercular adhesions had almost completely disappeared.

**Prognosis.**—Opinions as to the ultimate prognosis of ascitic and adhesive tubercular peritonitis differ much. Many regard the outcome of the disease as favorable in a considerable percentage of cases, while others believe the final prognosis extremely bad. All agree that the disease is rarely of itself fatal, but those who take a dark view of the subject consider that most of the patients ultimately die of some other form of tuberculosis. Our experience has been favorable.

It should be mentioned incidentally as a warning that when the abdomen is opened and tubercular peritonitis of the first two types is found, the wound should never be drained, for if this is done a persistent sinus is almost sure to follow.

Nodular tubercular peritonitis cannot easily be treated by surgery. The condition is usually discovered on opening the abdomen for expected intestinal cancer, appendicitis, or diverticulitis, etc. If the condition is such as does not absolutely require interference, like that of intestinal obstruction or abscess formation, it is best to leave the lesions alone. Attempts to remove the disease by intestinal resections are apt to be followed by permanent fecal fistulas. Even the nodular form of tubercular peritonitis may get well spontaneously.

To summarize the treatment of the disease, it may be said that general hygienic measures, such as are employed for tuberculosis elsewhere, are the most important. If a considerable amount of ascites is present, evacuation of the peritoneal cavity by a laparotomy incision probably hastens a cure. Most cases of adhesive and nodular tubercular peritonitis come to operation on account of the doubt in diagnosis. When peritoneal tuberculosis is found the abdominal wound is to be closed without drainage, without further operation, except when the disease is confined to the pelvic organs without serious involvement of the intestines, or when some condition is found which demands immediate surgical intervention.

# General Inflammatory Processes

## INFLAMMATIONS OF THE VULVA

The vulva is relatively immune to infections on account of the firm epithelial covering with which it is protected. It is, however, exposed to all sorts of inflammatory irritants, so that the absolute number of affections to which it is subject is sufficiently great.

Acute primary vulvitis is a rare occurrence except in children, in whom the gonococcus is the most important exciting organism. In the adult, vulvitis is usually secondary to inflammatory lesions elsewhere in the genital tract, such as may exist in the endometrium, endocervix, or vagina; or it may be the result of chemical irritation from the discharges of malignant or necrotic new growths above, or from diabetic urine or from vesical or rectal fistulas, where there is maceration and destruction of the superficial epithelium, so as to allow the invasion of pathogenic organisms. Vulvitis may also be caused by trauma and infection from masturbation or indiscreet coition, from scratching, or from uncleanliness and chafing during menstruation.

The symptoms of vulvitis are reddening and swelling of the parts, with pain and increased secretion. Edema of the labia minora is especially marked and may reach an alarming extent.

A special form of vulvitis, due usually to excessive scratching from pruritus, is a great swelling of the clitoris and prepuce, causing a condition like that of acute phimosis in man. The secretion which bathes the vulva in vulvitis differs according to the nature of the infection, the most profuse type appearing in gonorrhea. As the secretion dries, adhesions and ulcerations may form. The pain in the acute forms is severe and distressing, consisting of great heat and pressure, coupled with burning on micturition. As the process becomes less acute the pain often gives way to intolerable itching.

**Gonorrheal vulvitis,** including the vulvovaginitis of children, Bartholinitis, the infection of Skene's glands, and the forms of external gynatresia, has been treated under the subject of Gonorrhea, to which the reader is referred.

### SOFT CHANCRE

Soft chancre, or *ulcus molle,* occurs most commonly near the frenulum, but may appear in numerous small ulcers over the entire external genital apparatus and out on the thighs and buttocks. These ulcers are characterized by their multiplicity and their great tendency to cause suppurating inguinal buboes. The ulcers are usually small, with well-defined edges and covered with a thick purulent secretion. They are shallow, and are distinguished from syphilitic chancre by the absence of basal induration.

Soft chancres are venereal in origin. They are usually painful, and are

associated with a greater or less amount of vulvitis, which increases the discomfort. The buboes which are so apt to follow are extremely painful and usually suppurate. The chancres are, as a rule, easily controlled by applying to each ulcer some caustic solution like crude carbolic or chromic acid, followed by alcohol. The application of the acid is momentarily painful, but patients are usually entirely willing to submit to it.

The buboes can sometimes be made to subside and absorb by rest and the application of moist heat. If they suppurate it is necessary to incise and evacuate them, after which the wound goes through a process of slow healing. Patients with buboes should be kept in bed, as walking about greatly aggravates the condition.

### SKIN LESIONS

The most common skin affection of the vulva is that due to chafing, *eczema intertrigo*. This is seen especially in the sulcus, between the greater and lesser lips, and in the furrows between the vulva and the thighs. The skin is reddened or brownish red and may take on a permanent discoloration. The condition is usually due to uncleanliness, coupled with some irritating discharge from the upper genital or urinary tract, and is especially common in fat women and during hot weather. Other skin lesions seen are acne, herpes, psoriasis, molluscum contagiosum, etc. Lichen sclerosis is sometimes seen. It closely resembles kraurosis in appearance.

*Seborrhea* is quite frequent, and is characterized by a white secretion, mostly on the labia minora. The glands may form cysts which sometimes become infected and suppurate. The presence of these small sebaceous cysts, usually seen on the labia majora, may be a source of mental apprehension on the part of the patient. They often disappear spontaneously.

If the cysts are giving pain or causing anxiety, they may be dissected out under local anesthesia. Otherwise they need no special treatment.

**Furunculosis** is a disease that may be the result of uncleanliness, but it sometimes occurs periodically with menstruation. It may also appear as a specific disease, usually near the time of the menopause, in which case it seems to be the result of a local circulatory disturbance, possibly connected with deficiency of the ovarian function. This latter type may be much benefited by the use of ovarian extract.

**Syphilis.**—The primary syphilitic lesion of the vulva may have exactly the same appearance as that seen in man, characterized as it is by a smooth, sharply defined ulcer, with hard indurated base, and a livid coloration of the surrounding tissue. In woman, however, there is a much greater tendency to the formation of multiple primary ulcers, due chiefly to the fact that the labia minora lie in close proximity to each other, so that the infection is transmitted from one lip to the other. For this reason multiple syphilitic ulcers are often seen symmetrically located on both labia. The initial lesion may be situated on any part of the

external genitals, but it is found most commonly near the frenulum, the clitoris, and the inner surfaces of the labia minora.

The lesions are apt to be associated with hard edema of the surrounding parts

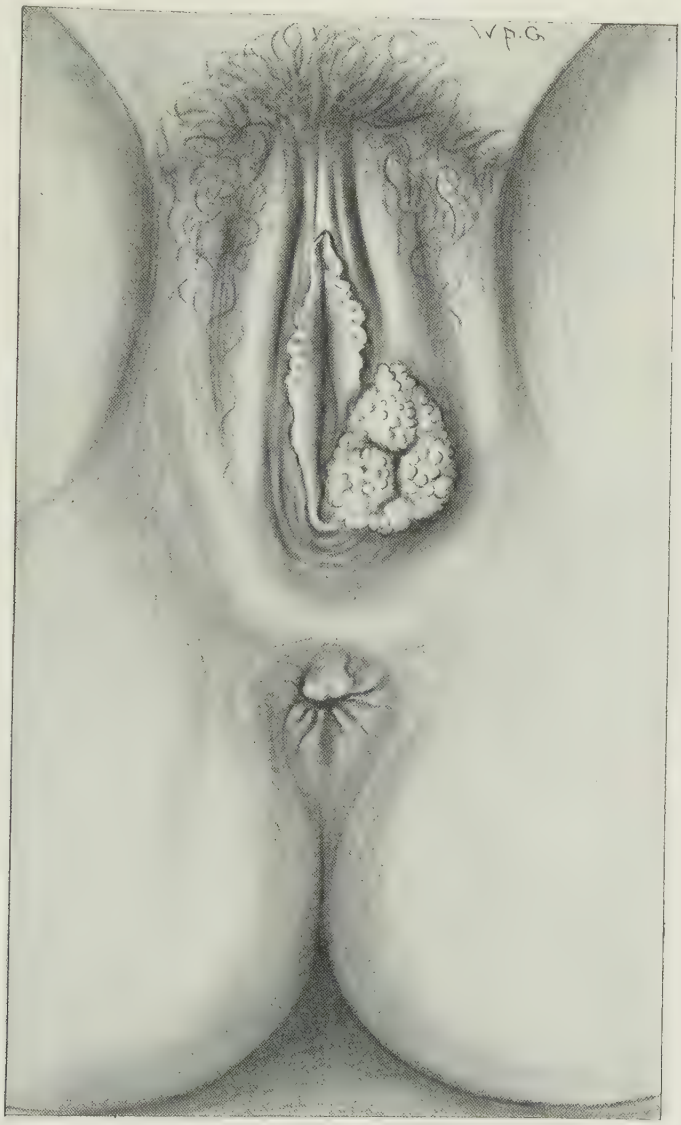

FIG. 50.—CONDYLOMATA ACUMINATA.
In this case the excrescences are collected into discrete masses. Usually the condylomata are more widely scattered over the vulva and surrounding parts.

and extensive erosions. Indolent buboes are felt in both groins, while later secondary efflorescent manifestations follow.

Owing to the local edema, multiple ulcerations, and erosion of the primary affection syphilis may be confounded with elephantiasis, tuberculosis, and

esthiomene. The diagnosis may be made absolute by finding the Spirochæta pallida and by a positive Wassermann reaction.

**Condylomata Acuminata.**—These are warty or papillary excrescences that appear on the labia and surrounding parts of the external genitals. Their origin is usually venereal and nearly always the result of gonorrhea. They have the form of pointed papillæ, and are termed "acuminata" to distinguish them from the broad condylomata that result from syphilis. These warty growths appear in clusters mostly on the major and minor lips of the vulva. Other warts, either

FIG. 51.—CONDYLOMATA ACUMINATA VULVÆ.

Low power. Section of a complete condyloma showing how the papillæ of the corium hypertrophy, growing outward, carrying the epithelium with them, giving the whole a wart-like appearance. The stroma beneath contains many dilated blood- and lymph-vessels.

singly or in clusters, are sown about over the neighboring parts of the buttocks and thighs. They may even invade the vagina for a short distance. Sometimes the clusters become very large. The condition is frequently mistaken for cancer, though to the experienced there is no difficulty in making a diagnosis. The condylomata of themselves do not give much trouble to the patient, but there is usually an associated leukorrheal discharge with consequent maceration and soreness of the parts. The appearance of the excrescences may cause great apprehension on the part of the patient.

The growth of the papillæ is entirely superficial, there being no tendency to grow down into the subcutaneous tissue. For this reason the treatment is very simple. It consists merely in scraping off the papillary growths with a sharp curet. The superficial excoriation of the skin may be painted with iodin and the healing process is very rapid. If the condylomata extend to the softer parts of the vestibule and vaginal orifice their removal may be attended by

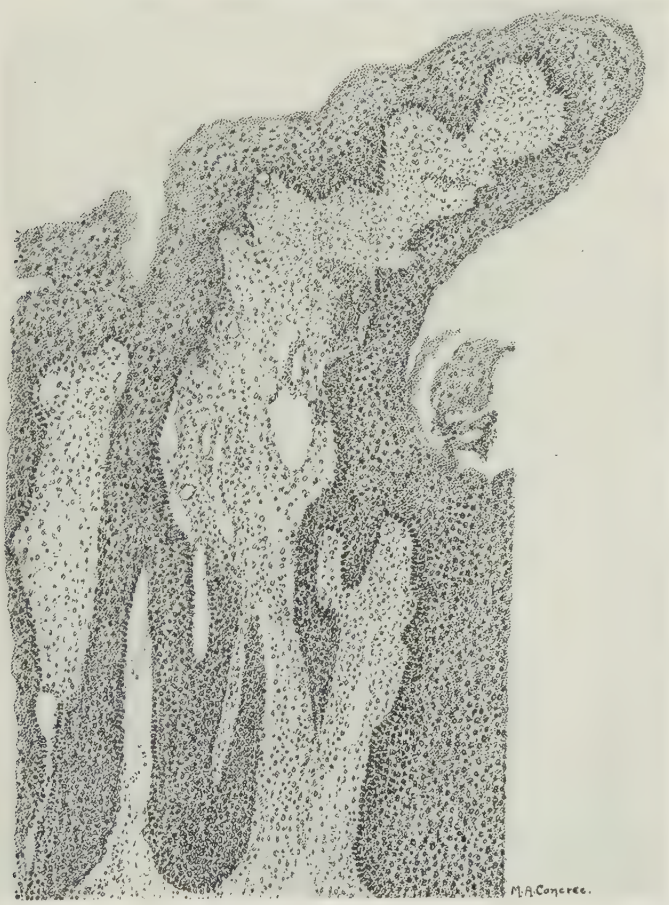

Fig. 52.—Condylomata Acuminata Vulvæ.

Higher power drawing of a papilla from the previous section. The epithelium is thickened, but the cells show no atypical growth and no signs of invading the stroma, as they do in carcinoma of the vulva. The stroma of the papilla contains several dilated blood-vessels and is infiltrated with leukocytes.

troublesome bleeding, especially if the patient happens to be pregnant. If the condylomata are at all extensive it is best to remove them under general anesthesia.

**Esthiomene** (Syphiloma Vulvæ).—The condition commonly called esthiomene consists of an hypertrophy and ulceration of the vulvar regions. It was given by early observers the designation "esthiomene" from a Greek word meaning to "gnaw out." Although its characteristics seemed to be those of

a tertiary syphilitic lesion, its etiology was long in doubt on account of the inconstancy of other luetic signs and its resistance to antisyphilitic treatment. Recent studies by A. Stein seem to point to syphilis as being the invariable cause of the disease, and for that reason he recommends that the word esthiomene be discarded in favor of syphiloma vulvæ. Under the term "syphiloma" Stein would include pseudo-elephantiasis and most cases of lupus vulvæ. Syphilomata of the vulva, according to Stein, are true gummata. They are apt

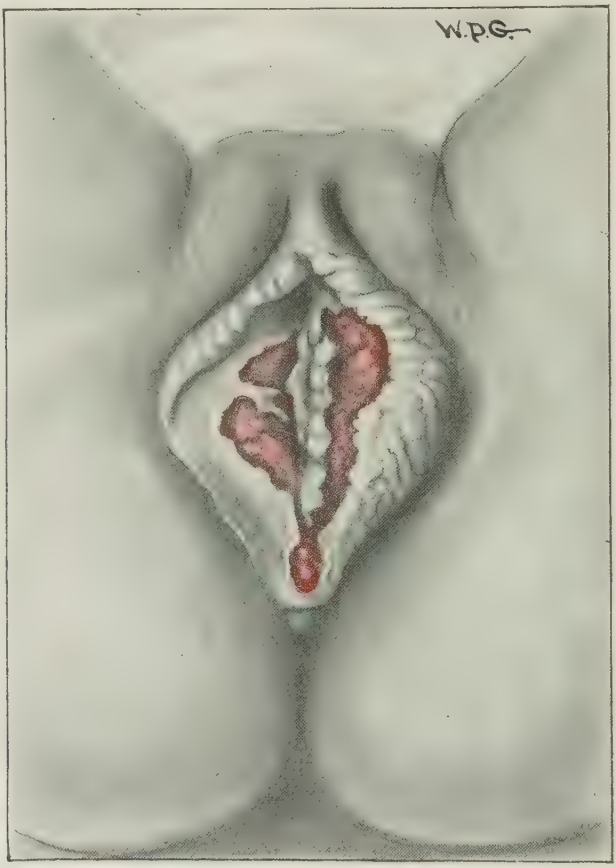


FIG. 53.—ESTHIOMENE.

The labia are hypertrophied, resembling somewhat elephantiasis. There is extensive ulceration of all the parts. The ulcerated areas have a tendency to be symmetric on the two sides.

to appear many years after the primary infection, and in the absence of luetic changes in any other part of the body.

This disease may originate in any part of the vulvar region and begins as a spreading diffuse hypertrophy of the parts. Ulceration ultimately takes place, especially on the inner surfaces of the labia. These ulcerations often have a symmetric form on the two opposing surfaces. In the advanced ulcerative cases the parts are bathed in an exceedingly foul purulent discharge. According to Stein the disease is for the most part painless. In a case observed by the

author the pain was excruciating, simulating that of advanced cancer of the vulva.

Syphiloma of the vulva is to be distinguished from true lupus or tuberculosis of the vulva by microscopic examination of the tissues, a distinction that it is sometimes difficult to make. In general appearance the disease is much like carcinoma, but the differentiation is easily made by microscope. It may involve neighboring parts, such as the urethra, vagina, and rectum, in which it may cause strictures.

The disease is apparently somewhat amenable to modern antisyphilitic treatment, which, however, should be combined with a radical vulvectomy.

### ELEPHANTIASIS VULVÆ

Elephantiasis relates to a coarse enlargement of the vulva involving the labia minora or majora, or both. The outer appearance of these growths varies considerably, special names being given to describe the differences in surface structure. Thus, elephantiasis glabra relates to a form which has a smooth surface; elephantiasis tuberosa, to a form which is covered with irregular nodules; elephantiasis condylomatosa, to one covered with warty excrescences (Gebhard). The hypertrophy may become very great, and the enlarging mass pedunculated, tumors having been observed weighing as much as 30 pounds.

In the course of time severe ulcerations may form, giving an appearance similar to that of esthiomene. Histologically, the process consists of a chronic indurative hypertrophy of the subepithelial connective tissue, excepting in the condylomatous type, in which, both microscopically and macroscopically, the excrescences are almost exactly like those of condylomata acuminata.

The etiology of elephantiasis is quite obscure. The disease appears during the age of sexual maturity. It is much more common in the Orient than with us, and for that reason it is supposed that it may be due to some parasite, possibly bilharzia (Jaschke).

Among some tribes of the Hottentots is seen with considerable regularity an enormous lengthening of the labia minora. The term "elephantiasis" is also applied to this condition.

Elephantiasis in many cases does not at first give symptoms. The growth may become exceedingly edematous, causing lymphorrhea. If the surface becomes ulcerated the condition may be very painful, resembling esthiomene. With the larger tumors coitus is entirely interfered with.

The treatment of elephantiasis is removal by a partial or complete vulvectomy, according to the extent of the enlargement.

A special form of elephantiasis is seen among the Southern negroes who live in the damp, swampy regions about the plantations. The disease has been shown to represent a condition of lymph-stasis, usually brought about by the Filaria sanguinis hominis, sometimes by syphilis and other eruptive diseases. The fibrous growth of the tissues is not due primarily to the lymph-stasis, but to recurrent erysipelatous infections of the affected part, each attack of which

leaves the tissues more hypertrophied (Hill). The disease is more common in men, affecting the scrotum or lower extremities. In women it is apt to involve the external genitals. It is quite likely that this form of the disease is identical with that described among the Orientals.

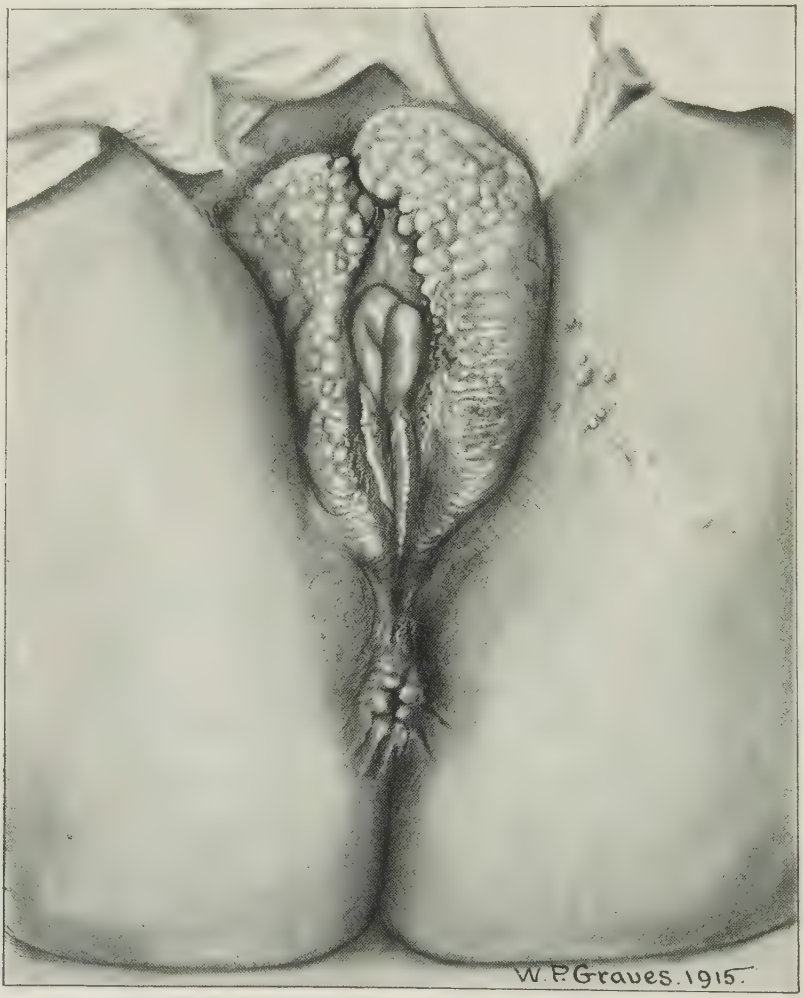


FIG. 54.—ELEPHANTIASIS VULVÆ.

There is great hypertrophy of the labia majora with a tendency to papillary outgrowth. On the left thigh can be seen several metastatic papillary excrescences and a scar where some of them had been removed at a previous operation. The treatment of this case was a complete vulvectomy.[1]

Certain cases of great hypertrophy of the vulva are commonly diagnosed as elephantiasis which should properly be classed with the syphilomata. Stein suggests the name "pseudo-elephantiasis" for these lesions. The subject is still in a state of confusion, for it seems quite probable that many of the classical cases of elephantiasis seen in the tropics may have a luetic basis.

[1] Operation by Dr. F. A. Pemberton, Free Hospital for Women.

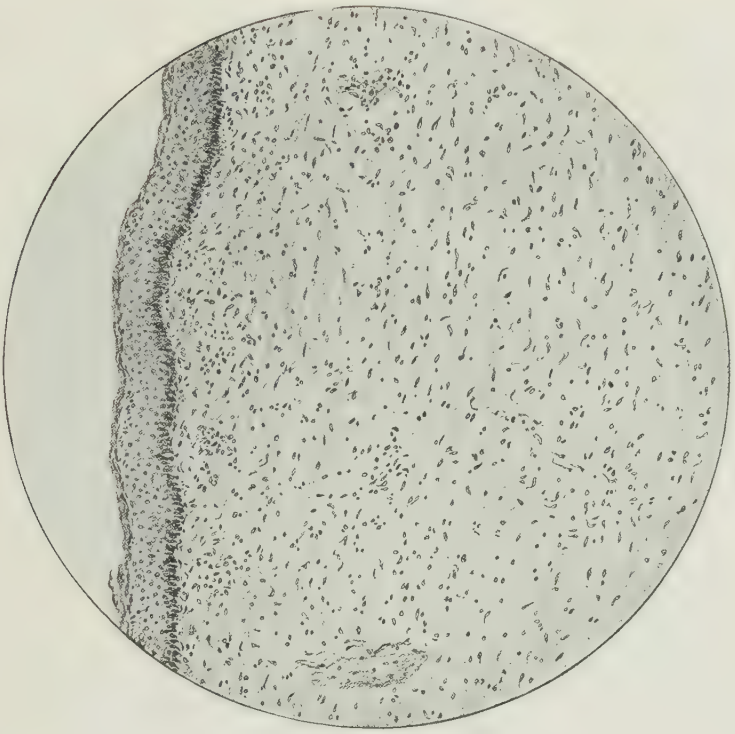

FIG. 55.—ELEPHANTIASIS OF THE VULVA.

Low power. Microscopically, this shows the characteristics of a fibroma. The thin layer of stratified squamous epithelium in which there are few, poorly developed, or no papillæ, lying on a loose connective-tissue stroma, with a few small round cells scattered through the tissue. Near the center are two dilated lymph-spaces.

## KRAUROSIS

The term "kraurosis" is derived from a Greek word meaning to shrink. In this disease there is a sclerotic change in the cutis of the vulva. The epidermis becomes thin and flattened, and there is an increase of connective tissue in the subcutis, together with a disappearance of elastic fibers and pigment. The result of this is that the surface of the vulva becomes white and parchment-like and is easily fissured. In the advanced stages the various parts of the vulva become obliterated and shrink to the consistency of leather. The process may extend to the anus. There is usually a fairly well-marked line of demarcation between the diseased and healthy skin.

The etiology of kraurosis is not always clear. There is no doubt that it is usually the result of a long-continued irritation caused by discharges which, by their chemical action, gradually alter the structure of the vulval cutis. A pruritus of the vulva from any cause soon produces a white parchment-like appearance, which, if the irritating cause continues, in some develops into a permanent change. Some, however, regard the pathologic process of kraurosis as an inherent primary disease. This theory has not been proved.

Kraurosis of the vulva is related to senile atrophy, and reference should be made to that subject.

It not infrequently serves as a starting-point for cancer of the vulva.

The symptoms of kraurosis consist chiefly of intolerable itching. Patients with this disease suffer pitifully and are often driven to acts of desperation.

FIG. 56.—KRAUROSIS VULVÆ.

The clitoris and labia minora have disappeared. The vulva is white and creased. The vagina is atrophied and stiff at the introitus. This was an extreme case and was inoperable on account of the extension of the disease into the orifices of the vagina and urethra.

The treatment of advanced cases is vulvectomy, if the process has not involved too much vestibule and vaginal introitus.

Several cures from ovarian extract have been reported, one of them by the author. In this condition ovarian extract theoretically works benefit by its power to cause hyperemia of the external genitals and thus improve the circulation. Results seem to bear out the theory.

Radiation both in the form of radium and Roentgen ray have been recom-

mended, but the results of this treatment have for the most part been disappointing.

*Leukoplakia* is a somewhat ill-defined disease, similar to kraurosis, but differing from it in that it appears in the form of whitish plaques scattered over the vulvar area rather than a general atrophic process involving the entire vulva. The histologic changes in leukoplakia are more superficial than those of kraurosis, being located in the epidermis. In kraurosis they are situated in the dermis (Taussig). Leukoplakia may be the seat of a primary cancer of the vulva.

*Paget's disease* occurs rarely in the vulva and may serve as a point of origin for cancer. It is characterized by local irritation, the formation of white blisters, thickening of the parts, and ultimate ulceration and bleeding. The disease in relation to the vulva has been described by Dubreullh. Taussig has recently called attention to the part it may play in the etiology of cancer of the vulva.

FIG. 57.—KRAUROSIS VULVÆ WITH PAPILLOMA.

## PRURITUS

Pruritus means itching, and describes strictly speaking, a symptom rather than a disease. Common usage, however, treats pruritus as a disease, and we shall, therefore, use the term in that sense.

Pruritus is closely related to kraurosis, which it always precedes as an earlier stage. It is characterized at first by a reddening and thickening of the vulval cuticle associated with intense burning and itching. The surface gradually becomes pale and parchment-like, with a tendency to cracks and fissures. As the process continues it merges into the condition of kraurosis. There is no marked dividing line between pruritus and kraurosis, and they must be regarded as different stages of the same pathologic process.

Pruritus, like kraurosis, is usually secondary to some irritating discharge that produces the skin changes by chemical action. It is, however, considered by some to constitute sometimes a primary disease, consisting of an essential fibrosis or sclerosis of the epidermis. In other words, the pathologic changes are identical with those of kraurosis. It would be better, therefore, to apply the term *kraurosis* to the changes in the tissues and the term *pruritus* to the symptoms resulting therefrom.

Pruritus of the vulva is usually the result of a discharge from some part of

the upper genital or urinary tract, and when a patient suffering with this symptom presents herself the most careful examination should be made to discover the cause.

The **causes** of pruritus are numerous, a diabetic urine being foremost among them. Pruritus in this case is due to chemical irritation. If the sugar in the urine is sufficiently reduced the itching ceases. Patients suffering from pruritus should always have the urine examined for sugar at once as a routine measure. Leukorrheal discharges from various sources sometimes produce pruritus. Examples of this are the irritating discharges from cancer of the uterus, necrotic polyps, sloughing fibroids, pessaries, cervicitis, and endocervicitis. A very important cause is partial atresia of the vagina or cervix, in which the normal menstruation and mucous secretion, not having proper drainage, become infected or chemically changed, and thus serve as severe irritants to the external genitals.

FIG. 58.—KRAUROSIS VULVÆ.

Low power. On the surface is a thick stratum corneum, under which is the stratum granulosum, much thinner than normal. The line between this layer and the corium is less wavy than usual, due to poor development of the papillæ of the corium. The corium consists of dense connective tissue containing few nuclei.

In women near or past the menopause senile atrophy is a very common etiologic factor in producing pruritus. Senile atrophy of itself brings about a change in the vulva that is somewhat similar to that caused by long-continued pruritus—*i. e.*, a thinning and flattening of the epidermis, coupled with an increase of con-

nective tissue and loss of elastic fibers. By this change the vulva is more susceptible to chemical irritation. Senile atrophy, moreover, is the means of creating abnormal secretions. It often produces an excessive desquamation of the vaginal epithelium which results in an irritating vaginitis. Senile atrophy, by contracting the vaginal outlet or by partially or intermittently sealing the cervical os, may prevent proper drainage of the vaginal or uterine secretions and thus render them chemically irritating. Other causes of pruritus are furunculosis and seborrhea of the labia majora.

The **treatment** of pruritus is primarily to find the cause of the irritation, and this can generally be done. Diabetes and the grosser lesions mentioned above are readily detected and treated by the accepted methods. The importance that senile atrophy plays is not sufficiently well recognized, and there is little doubt that many of the cases in which the disease is thought to be primary fall into this class. The principle to be observed in the treatment is to secure proper drainage of the vaginal and uterine secretions. A valve-like perineal outlet must be treated by a plastic operation which will secure a funnel-shaped introitus. Obstructing atresia of the vagina must be operated on in the manner recommended for that condition.

Atresia of the cervix is treated by creating an artificial laceration so that the lips will pout outward. If the atresia of the cervix is too high for the performance of a plastic operation, dilatation is first performed, and if atresia recurs, as it sometimes does, it may be necessary to remove the uterus and cervical canal by the operation suggested on page 772.

If the pruritus is due to a senile vaginitis where there is no obstruction, iodin applications to the vagina usually control the discharge.

Palliative measures usually give only temporary or fleeting relief. These consist usually of cooling lotions or salves, in which carbolic acid, alcohol, hamamelis, and menthol are the most commonly used ingredients. Pure ichthyol smeared on the itching parts sometimes gives relief. Various suppositories of codein, cocain, etc., are sometimes prescribed. Radium and the *x*-ray sometimes give great relief.

If the condition has continued for so long that a permanent change has taken place in the tissues, the process is to be classified as kraurosis, and is then essentially a disease. If this stage is reached the removal of the original cause may not relieve the symptoms. Vulvectomy may then be necessary. Before performing this operation it is well to try a course of ovarian extract, 5-gr. capsules four times daily. The author has had success with ovarian extract in a case of furunculosis which caused pruritus.

## VAGINITIS (OR COLPITIS)

When one considers the amount of trauma that the vagina is subjected to from coitus, childbirth, medical examinations, instrumentation, introduction of foreign bodies, etc., and its exposure to infectious organisms that are introduced by coitus or manipulation, or that may be transmitted from the neighboring

outlets of the bladder and rectum, it is a matter of wonder that inflammations play so unimportant a part. The comparative immunity of the vagina to infection is due partly to the protecting squamous epithelium that lines its surface and partly to its normally acid secretion, which is inimical to the growth of many microörganisms. Thus, we have already seen that the vagina, though susceptible to various infections, especially that of the gonococcus, in the early years of life, is, during maturity, rarely the seat of primary inflammations. Excepting in childhood, inflammatory processes in the vagina presuppose some mechanical or chemical injury to the surface epithelium that allows invasion of pathogenic germs. For example, the vaginitis seen in gonorrhea of adults is the result, first, of maceration of the vaginal epithelium by the catarrhal secretion from a gonorrheal endocervicitis, and, secondarily, of an infection by other organisms of the damaged surface. Furthermore, certain circulatory changes, which cause a local hyperemia of the vaginal blood-vessels, favor inflammatory processes in the vagina. Thus, infections are more common during pregnancy or in conditions attended with passive congestion, such as are seen in cardio-renal and liver diseases or with constant masturbation.

Vaginitis may occur as an acute diffuse inflammatory process in the vaginal wall. The diffuse form, as a rule, occurs only in the young, and is especially exemplified in the gonorrheal vaginitis of children, though it sometimes is seen in the adult. Here the entire vaginal membrane is red and swollen, easily bleeding, and profusely bathed in the inflammatory secretion.

In the localized chronic form of vaginitis the process is confined to certain areas of the vagina which gives a spotted or mottled appearance to the surface. This type is especially marked at the time of senile atrophy, when the reddened, easily bleeding spots of inflammation show in clear contrast to the smooth pale atrophic surface of the normal vaginal mucous membrane. The reddened spots vary from a pin-point to a centimeter or two in size.

Vaginitis in all stages may be attended with loss of surface epithelium and ulceration, with possible later permanent adhesions of opposing vaginal surfaces. In this way are formed most of the partial or complete atresias of the vagina.

All forms of vaginitis are attended with a leukorrheal discharge which varies greatly in amount and consistency. In the acute diffuse type of vaginitis the dischage is purulent and creamy and very profuse. In the milder forms of chronic vaginitis it has more of a turbid, serous character, while in the senile type it is white and milky, due to the great amount of desquamated epithelium contained in it. If there is bleeding from the vaginal surface the dischage is brownish or even red.

**Causes of Vaginitis.**—The two most common causes of vaginitis are gonorrhea and senile atrophy (*q. v.*). Syphilis and tuberculosis of the vagina are rare causes.

Long-standing endocervical catarrh may keep up an intractable vaginitis, as may also a chronic endometritis, masturbation, and excessive coitus.

A very frequent cause of vaginitis is neglected pessaries or tampons. Pes-

saries that are ill-fitting, or that are retained for long periods without proper cleanliness, ulcerate the vaginal epithelial surface, and may even be buried in the wall by a new growth of epithelium. Other foreign bodies kept in the vagina may produce ulceration and chronic inflammation.

Prolapse of the vagina and uterus causes by exposure a thickening and cornification of the vaginal mucous membrane. If the prolapse is extreme and the surface is subjected to constant trauma, the most prominent parts become seats of decubitus or pressure ulcers, which, if not properly treated, become infected and covered with a slimy secretion.

Vaginitis may rarely attend infectious diseases like measles, scarlet fever, typhoid, small-pox, diphtheria, and cholera. In these cases the vaginitis is of the diffuse type, the canal being covered with a croupous membrane. Ulceration and atresia may be the end-result of such inflammations.

Circumscribed vaginitis is occasionally seen with puerperal fever, and may be followed by obstructing adhesions of the vaginal wall, usually in the upper part of the vagina near the portio.

Partial atresia of the vagina or cervix is usually attended with vaginitis on account of the damaging influence on the surface epithelium of the stagnant and chemically changed secretions.

Among children an acute vulvovaginitis simulating that caused by gonorrhea may be set up by wandering thread-worms from the rectum, chiefly the Oxyuris vermicularis. Cases are on record in which this parasite has traveled from the vagina through the uterus and tubes to the peritoneal cavity with serious results.

Other vaginal parasites are the Amœba urogenitalis, a protozoan which invades also the bladder, causing hematuria, and the Trichomonas vaginalis, which flourishes in the acid secretion of the vagina. Still another parasite, Distoma hæmatobium (formerly called Bilharzia hæmatobia), is found in a large percentage of Egyptian women. This organism infests chiefly the urinary tract, but in some cases it propagates on the vulval epidermis, where it causes excrescences very like condylomata acuminata. It sometimes invades the vaginal mucous membrane, in which it produces a thick, leathery infiltration. On the cervix it causes papillary outgrowths of a carcinomatous appearance (Füth).

Various forms of fungi produce an inflammation of the vagina which macroscopically exhibits white plaques on a diffusely reddened mucous membrane. The growth of fungi in the vagina is especially favored by a diabetic urine.

**Symptoms.**—In the milder forms of chronic vaginitis there may be no definite subjective symptoms unless the discharge is chemically irritating, in which case there is burning and itching of the external genitals with frequency or pain on micturition. If the vaginitis is more severe or acute, there is a sense of burning and weight in the vagina, the sensations being usually referred to the pelvis, so that the patient often thinks that she is suffering from a falling of the womb. The leukorrhea is always noticed by the patient, and it is this manifestation that usually brings her to consult her physician.

**Treatment.**—The first step in the treatment of vaginitis is to discover and direct attention to the primary source of the irritant that is maintaining the vaginal inflammation. This can usually be done, for, as we have seen with the exception of the somewhat uncommon specific local infections of gonorrhea, tuberculosis, and syphilis, the initial trouble lies elsewhere than in the vagina. Unfortunately, the vaginitis does not always disappear after the instigating cause has been removed. The local treatment of the vagina itself consists chiefly in the use of douches (salt solution, boric acid, alum, sodium bicarbonate, permanganate of potash, irrigol, the silver preparations, etc.) and certain local applications, of which tincture of iodin is by far the most valuable. In some cases tampons soaked in glycerin and ichthyol are useful if employed in connection with douches and iodin. Vaginal suppositories of ichthyol may be used in the same way, but are not very efficacious. Senile vaginitis, if not the result of obstruction of secretions, is best controlled by painting the vagina with iodin without the use of tampons.

The progress of vaginitis, as far as complete cure is concerned, is often unfavorable. It is best to treat the intractable cases in a hospital, where competent nursing and systematic treatment will often accomplish in a short time results that weeks of office or out-patient treatment fail to secure.

**Ulceration of the Vagina.**—Vaginal ulcerations resulting from ill-fitting pessaries or from the chafing of a procidentia are common. Ulcers from other causes are comparatively rare. The reader who is especially interested in this subject is referred to an article by Schröder and Kiehlmann entitled "Die Ulcerationen der Vagina," published in the Arch. F. Gynaek., 1921, cxv, 145. These authors divide the special vaginal ulcers into ten groups, as follows: 1. Round ulcers; simple ulcers without specific microscopic changes. 2. Phagedenic and aphthous ulcers with marked tissue destruction. 3. Tuberculous ulcers, primary or secondary, diagnosed by microscopic sections. 4. Luetic ulcers, primary or secondary, the last tending to phagedenic destruction in pregnant women. 5. Soft ulcers, associated with inguinal bubo. 6. Multiple small ulcers resulting from infection from the anus. 7. Diphtheric ulcers, primary and secondary. 8. Uremic ulcers. 9. Ulcers due to drugs, such as mercury, chromic acid, etc., including also ulcers from radium burns. 10. Varicose ulcers, very rare.

**Vaginitis Emphysematosa.**—This is a special disease that occurs almost exclusively during pregnancy and disappears after delivery. There is little or no discharge resultant from it, and few symptoms, so that it often passes unnoticed. It is characterized by small blebs of the vaginal surface, which sometimes reach the dimensions of small cysts. Upon incising them a small amount of gas escapes.

The etiology of this condition has not been clearly proved, but it is supposed, on fairly good evidence, that it is the result of some gas-forming bacillus.

The clinical importance of this disease is insignificant.

**Garrulitas Vaginæ.**—This is a condition which is characterized by the audible escape of gas from the vagina following certain quick changes of bodily position, and which has been thought to be the result of gas-forming bacteria in the vagina. It is more likely entirely mechanical in origin, the result of incomplete valvular closure of the introitus (Jaschke).

**Paravaginitis (paracolpitis)** relates to an acute phlegmonous inflammation of the tissue surrounding the vagina. It is the result of deep infection following some serious lesion of the vagina, such as may occur from instrumentation at childhood, violent coition, attempts at criminal abortion, etc. Such an inflammation may become of the gravest import by extending to the pelvis and causing a fatal septic peritonitis. The infection may remain localized and has, during healing, an especial tendency to cause atresia of the vagina.

FIG. 59.—CHRONIC ENDOCERVICITIS.

Low power. Near the top are five cervical glands in cross-section, lined by the typical cylindric epithelium. The tissue around them is infiltrated with leukocytes. To the right of these glands and in the lower part of the section are areas of squamous epithelium which has grown down into the glands, filling them. These areas are typical stratified squamous epithelium and must be differentiated from carcinoma.

Treatment is carried out by hot or cold antiseptic douches, with application of rubber or glass plugs during convalescence to prevent the formation of vaginal adhesions. Localized abscesses require incision and drainage.

**Exfoliative vaginitis** relates to a rare condition in which the entire vaginal mucosa is exfoliated in the form of a cast. It is to be differentiated from a pseudomembranous exudation sometimes seen in which a fibrinous coating is formed on the surface of the vaginal mucosa. The most common cause of true exfoliative vaginitis is the application of a very hot douche or of some severe chemical irritant such as phenol or zinc chlorid, or of some powerful

astringent like tannic acid. A few cases have been reported in which no thermic or chemical cause could be traced, the condition simulating that of exfoliative dysmenorrhea. The most notable of these cases is that of W. Kerwin, in which the patient discharged a vaginal membrane forty times in the course of a year.

**Syphilis of the Vagina.**—Primary lesions of the vagina are rare owing to the resistant nature of the vaginal mucosa. When they do occur they present

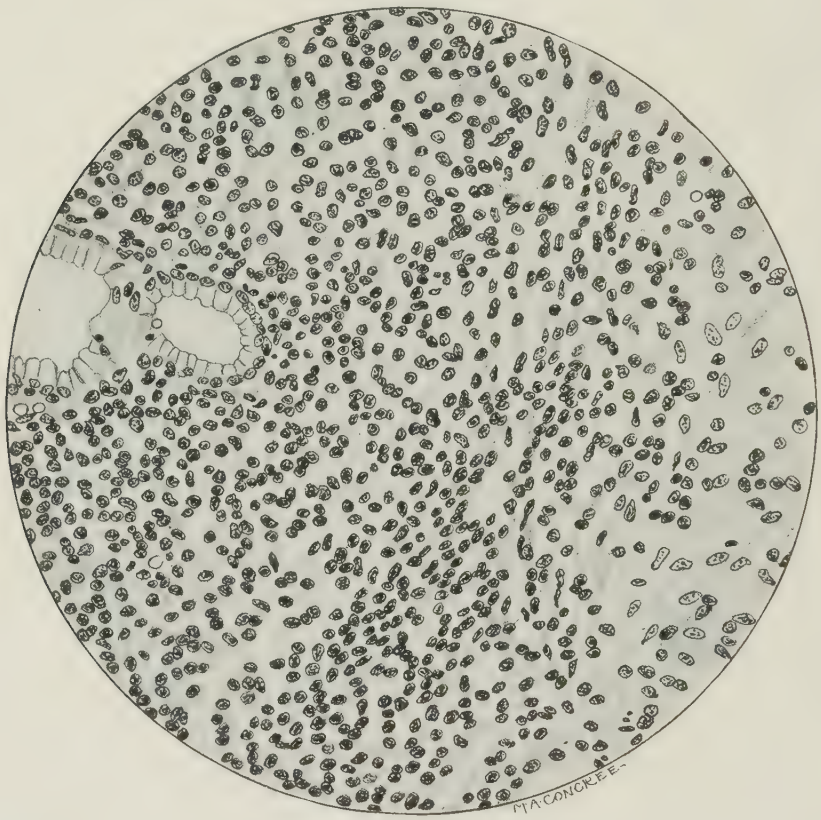


Fig. 60.—Chronic Endocervicitis.

High power. On the left is a cervical gland the epithelium of which is being invaded by lymphocytes. The rest of the drawing shows the stroma of the cervix infiltrated with leukocytes, mostly of the mononuclear variety. This infiltration occurs around the glands, as would be expected, because bacteria gain entrance through them.

the typical parchment-like induration characteristic of the lesion in other parts of the body. They usually persist for only a short time and leave a scar that is difficult to distinguish. As they cause no definite symptoms they are seldom diagnosed. Secondary syphilitic lesions in the form of macules or papules are rarely seen, as they are symptomless. Tertiary lesions, according to Gellhorn, nearly always represent extension from ulcerating gummata of the external parts. They may result in fistulæ or strictures.

## CERVICITIS AND ENDOCERVICITIS

Non-specific infections of the cervix and cervical mucous membrane are, in the majority of cases, due to lacerations that result in erosion or ectropion. This subject is treated in the section on Lacerations from Childbirth.

Erosion of the cervix is occasionally seen in virgins, and is accountable for the persistent leukorrhea from which they sometimes suffer. The cause of these

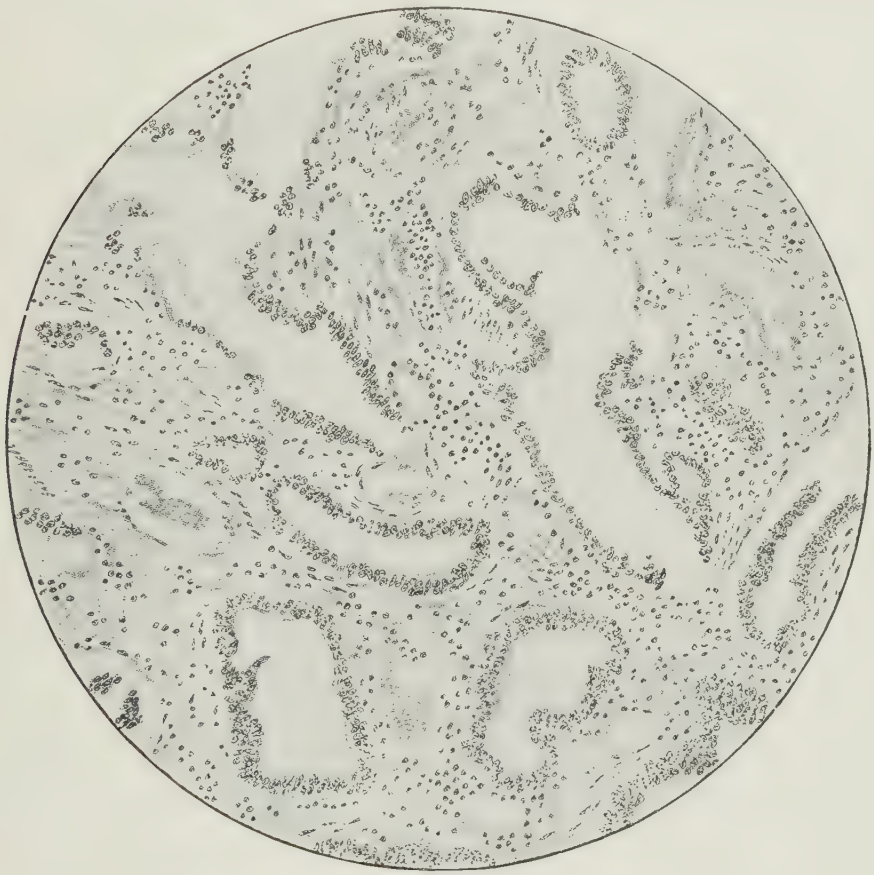

Fig. 61.—Chronic Endocervicitis. High Power of the Cervical Glands.

The glands are dilated and were filled with mucus containing desquamated epithelial cells, round cells, and bacteria, but have become emptied in preparing the section. At places, as in the upper left corner, the epithelium is absent. The stroma between the glands is edematous and infiltrated with round cells.

erosions is not definitely known. It is probable, however, that it is due to abnormal mechanical irritation, for the condition is most frequently seen when there is a malposition of the cervix, so that it impinges on the anterior vaginal wall, or when the cervix is disproportionately long, so that it is in too close contact with the posterior wall.

In cases of genital atrophy and vaginitis the cervix may take part in the

inflammation and result in plastic adhesions, causing atresia with hydro- or pyometra (*q. v.*).

The **symptoms** of endocervicitis and cervicitis consist of leukorrheal discharges. The treatment is either local application of iodin or an operation

FIG. 62.—CHRONIC CERVICITIS. PSEUDOHEALING OF AN EROSION.

High power. The left half of the picture shows the duct of a gland occluded by the stratified squamous epithelium of the cervix which has grown over and down into it. On the right is a duct down into which the squamous epithelium is growing along the wall, but which has not become occluded. Below the squamous epithelium is seen the normal cylindric epithelium which lines the glands of the cervix.

which will restore the cervix to its normal contour and position. Very intractable cases can be cured by Schröder's or Sturmdorf's operation of complete removal of the cervical mucosa (*q. v.*).

**Syphilis of the Cervix.**—Primary chancre of the cervix is somewhat rare, its frequency amounting, according to Gellhorn, to not more than 1.5 per cent. of all primary chancres found on the genitalia. It is frequently overlooked. It is practically symptomless and heals with great rapidity. The diagnosis is not easy on account of the absence of buboes and the difficulty of determining

by palpation the characteristic induration of the base of the lesion. The diagnosis can be made accurately only by recovering the Spirochæta pallida from the surface and by the sequence of a typical secondary exanthema. Secondary and tertiary syphilis of the cervix have been only rarely observed. Gellhorn and Ehrenfest have observed spirochetes in normal cervical secretions in patients during the secondary stage of syphilis even when there are no specific lesions about the genitalia. (For the most authoritative descriptions of cervical and other syphilitic lesions of the female genitalia the reader is referred to the well-known writings of Dr. George Gellhorn. For a general résumé of the subject read the article by Gellhorn and Ehrenfest in Trans. of Amer. Gynec. Soc., 1916.)

**Syphilis of Endocervix.**—Gellhorn has reported a case of typical secondary syphilitic ulcerations occurring on the endocervical mucosa of a lacerated cervix. Inasmuch as such lesions could not ordinarily be seen, Gellhorn thinks that this case may explain the finding of spirochetes in the secretions from apparently normal cervices.

## ENDOMETRITIS

The mucous membrane of the body of the uterus, or endometrium, is a tissue which has been greatly misunderstood. It is, in reality, a comparatively inoffensive tissue, and very little responsible for the many ills formerly ascribed to it.

The destiny of the endometrium is primarily to be the soil for the implantation of the impregnated ovum. It is doubtless for this reason that nature provided that it be comparatively immune to the infections and malignant growths common to other membranes. Thus, we have seen that, except in the puerperal state, it is protected against practically all infectious organisms except the tubercle bacillus and the gonococcus. Even tuberculosis of the endometrium is quite uncommon, while the gonococcus, in its passage from the endocervix to the tubes, resides only for a short period on the endometrial surface and rarely leaves any permanent trace of its sojourn.

During the puerperium, however, when a part of its surface is lacerated and denuded by the separation of the placenta, the remaining part swollen to a vulnerable decidua, and the protective barrier of the internal os stretched widely open, the endometrium is exposed and susceptible to the attack of infectious organisms. It is at this time that the more serious inflammations of the endometrium occur, and from these attacks the chronic inflammatory changes more commonly date their origin.

The subject of endometritis is at present in a considerable state of confusion due to the fact that the terminology which is in common use has been handed down from a time when the pathology of the endometrium was little understood. In some of the older books no clear distinction was made between the mucous membrane of the body and that of the cervix, so that diseases were ascribed to the endometrium which, in reality, are localized in the endocervix. In fact, the

endometrium was supposed to be affected in most forms of pelvic disease, and this led to a great deal of local treatment and cureting that was not only not necessary, but often harmful. Thus, patients with pelvic inflammation, misplacements, leukorrhea, and irregular menses were apt to receive vigorous treatment of the endometrium as a routine measure. The term "endometritis" was loosely applied to all the changes in the uterine canal, and it was supposed that the effects arising from this disease were serious and far reaching. More

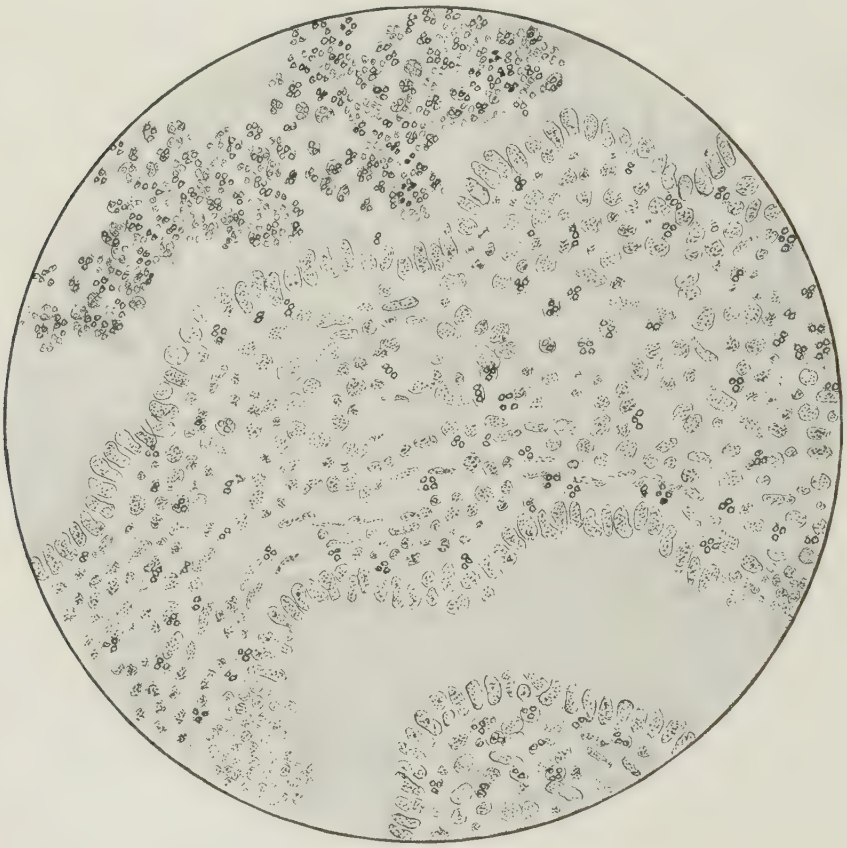

FIG. 63.—ACUTE ENDOMETRITIS.

High power. Parts of two glands are seen. The stroma between them is edematous, the cells are swollen, the nuclei large, and it is infiltrated with leukocytes. In the upper part of the drawing is a mass of exudate in the lumen of glands consisting of leukocytes, epithelial cells, and mucus.

recent studies have entirely changed this erroneous conception of the endometrium, and it is now known that this membrane plays only a comparatively small part in gynecologic disease.

In the first place, we must limit the word "endometritis" only to such conditions as imply a true inflammatory process in the endometrium. This relates to infections by pathogenic organisms and to chronic changes that result from these infections. The circulatory changes, both physiologic and pathologic,

must be given appropriate names, and not be included as formerly under the misleading title of "endometritis."

No entirely satisfactory classification of the diseases of the endometrium has yet been made, and we must be content to try and simplify the subject as much as possible.

The changes of the endometrium, formerly included under the general term "endometritis," may be divided into three types: (1) Infectious endometritis, the

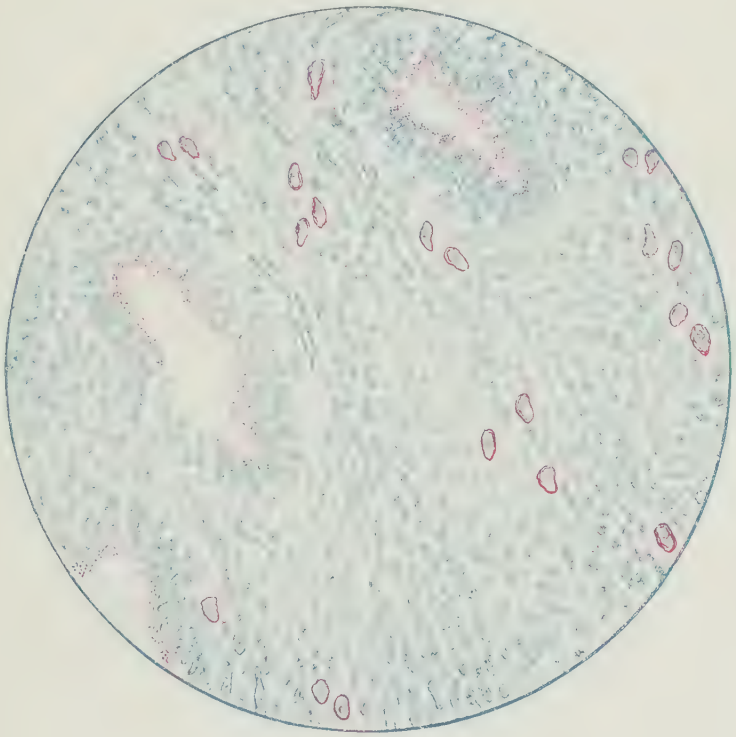

FIG. 64.—CHRONIC INTERSTITIAL ENDOMETRITIS.

High power. This section is stained to show the plasma cells which are found in chronic inflammatory conditions, and are important in this special disease because their presence in large numbers makes the diagnosis more certain. They are characterized by their large size and the excentrically placed nucleus.

result of microbic invasion; (2) chronic interstitial endometritis, resulting from a previous infectious attack, and (3) gland hypertrophy, resulting from circulatory changes.

## INFECTIOUS ENDOMETRITIS

Serious infections of the endometrium occur most commonly as a result of puerperal sepsis. The endometrium is at this time in a peculiarly exposed condition owing to the denudation resulting from the separation of the placenta, the patency of the cervix, and the general vascularity of the parts. The organisms which most commonly attack the endometrium at this time are the streptococcus, the staphylococcus, and the latent gonococcus. The inflammatory proc-

ess may remain localized in the endometrium or it may extend deeply into the muscular wall of the uterus. It may spread to the pelvic cavity and cause a peritonitis either by extension through the tubes or through the lymph-spaces of the uterine wall to the parametrium.

Infectious endometritis may result from gonorrhea. The most serious forms of gonorrheal endometritis are caused by the lighting up by the puerperium of a

Fig. 65.—Interstitial Endometritis.

High power. This illustrates the diffuse infiltration of the stroma with small round cells which can be seen scattered throughout the section. The stroma cells are swollen and there is some edema.

latent gonorrhea. Under these circumstances the endometrium does not possess its normal immunity to the gonococcus, and the infection may be severe and dangerous. This invasion of the gonococcus accounts for many cases of puerperal sepsis, the later results of which are manifested by chronic inflammation and one-child sterility.

Outside of the puerperal state infectious endometritis is astonishingly uncommon. Routine curetings, removed for diagnosis in vaginal operations, and

the cases of pelvic inflammation requiring hysterectomy supply ample material for the microscopic study of the endometrium. The percentage of true infectious endometritis is very small, while evidences of acute purulent inflammation are rare.

**Treatment.**—Acute infectious endometritis, outside of puerperal sepsis, is not a disease requiring specific treatment except in unusual instances. It must be always remembered that the use of the curet in any septic condition

FIG. 66.—CHRONIC INTERSTITIAL ENDOMETRITIS.

Low power. This section shows the dilatation of the glands which is sometimes found in this condition. The epithelial cells are low and inactive, the glands are usually circular, while in premenstrual dilatation they are irregular in outline. The stroma is denser than normal and collections of small round cells can be seen.

of the endometrium is dangerous, for it opens new avenues for the spread of the inflammatory process to the pelvic peritoneum. The endometrium may be infected by the passage of unclean instruments past the internal os. It is also possible to cause infection during a cureting operation by carrying organisms from an infected endocervix and implanting them on the endometrium. This is another of the dangers in using the curet.

Tuberculosis of the endometrium comes under the heading of Infectious Endometritis. It is discussed on page 253.

Senile atrophy sometimes predisposes the endocervix and endometrium to infection which produces plastic adhesions and partial or complete atresia. The result may be the backing up of pus in the uterine canal, so-called pyometra (*q. v.*).

### CHRONIC INTERSTITIAL ENDOMETRITIS

This is a condition the pathology and symptomatology of which are not sufficiently understood. It consists in a structural change in the endometrium

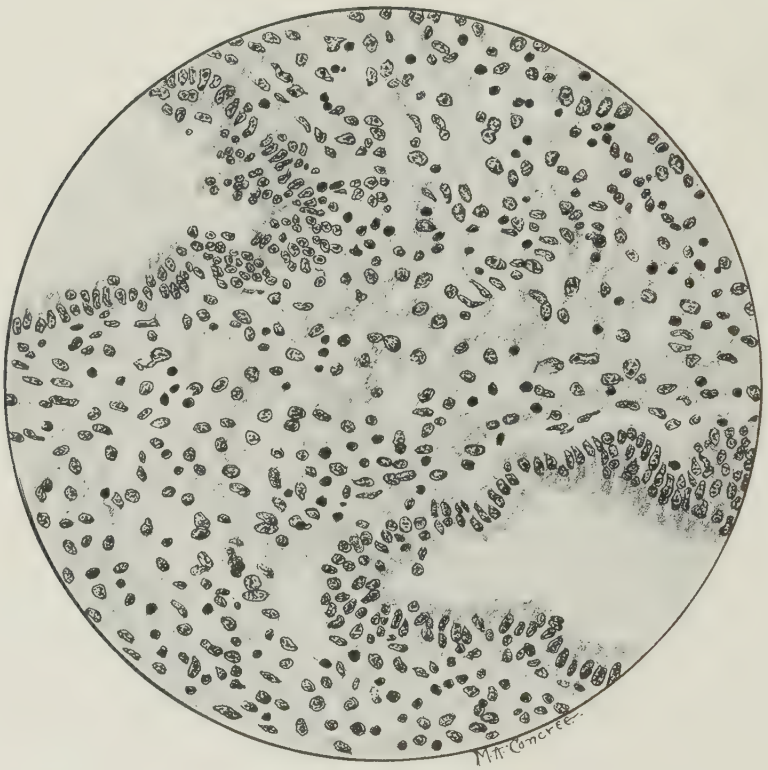

FIG. 67.—CHRONIC INTERSTITIAL ENDOMETRITIS.

High power. Parts of two glands are seen, the epithelium of which is infiltrated with round cells. The stroma is edematous, infiltrated with round cells, and has an increased amount of fibrous tissue.

which is evidently the result of some previous active infectious process. In our series of cases there is a noticeably large percentage of abortions in the patients' histories, while many of the cases had associated pelvic inflammatory disease.

The endometrium is thickened to a greater or less extent. Under the microscope the thickening is seen to be due to an increase of the stroma, in which there is a marked infiltration of small round cells. This condition is probably one of the factors which sometimes cause abnormal bleeding in association with pelvic

inflammation. Chronic endometritis cannot be easily diagnosed, nor can it often be satisfactorily treated as a disease by itself, for local applications to the endometrium are not feasible, while a cureting may light up into dangerous activity a latent pelvic inflammation.

There are various grades of chronic inflammation of the endometrium which are of interest microscopically, but which cannot be distinguished by clinical symptoms.

Driessen has described a special form of endometritis which he calls "postmenstrual necrobiotic endometritis," the clinical symptom of which is profuse and protracted menorrhagia.

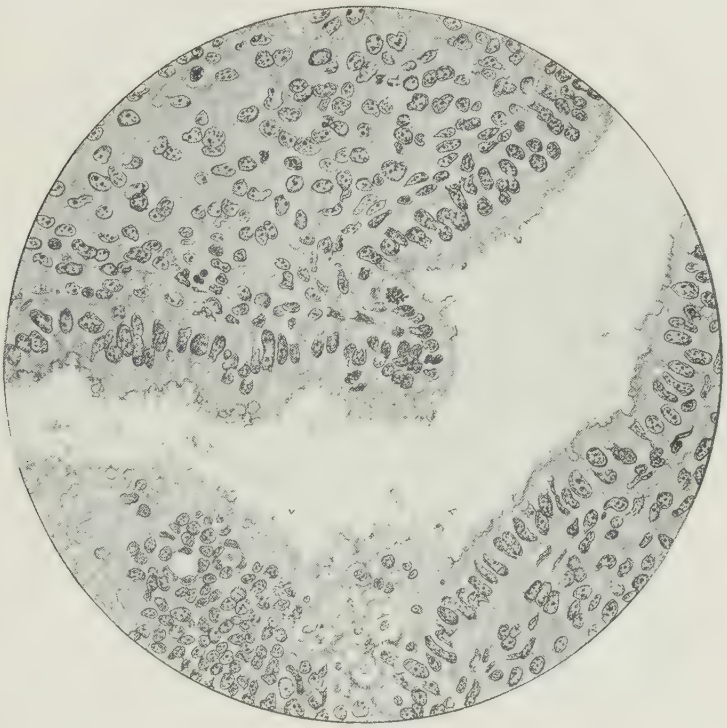

FIG. 68.—CHRONIC INTERSTITIAL ENDOMETRITIS.

The endometrium in these cases is found to show necrosis, hyaline degeneration, infiltration with multinuclear leukocytes, dilatation of the vessels, cystic dilatation of the glands, proliferation of the epithelium, and deficient glycogen. He also finds signs of incomplete regeneration of the uterine mucosa, such as is seen in endometritis following abortion.

Driessen explains this condition on the ground that on account of some irregularity in ovulation and menstruation the mucosa is not cast off as it should be normally, and that the portions of the mucous membrane remaining and disintegrating in the canal prevent a normal regeneration of the endometrium with consequent bleeding, as do the remnants of an abortion or the decidua. Cureting may cure or only temporarily relieve the condition.

## GLAND HYPERTROPHY

Various forms of hypertrophy of the endometrium, formerly thought to be the result of inflammation and called endometritis, are now known to be the result of circulatory changes. Until recent years all hypertrophied endometrium was generally supposed to be a pathologic process. Scientific study has shown that the endometrium undergoes a definite physiologic cycle of hypertrophy each month corresponding to the menstrual congestion. This change is characterized by a general thickening of the membrane. The stroma is swollen by a congestion

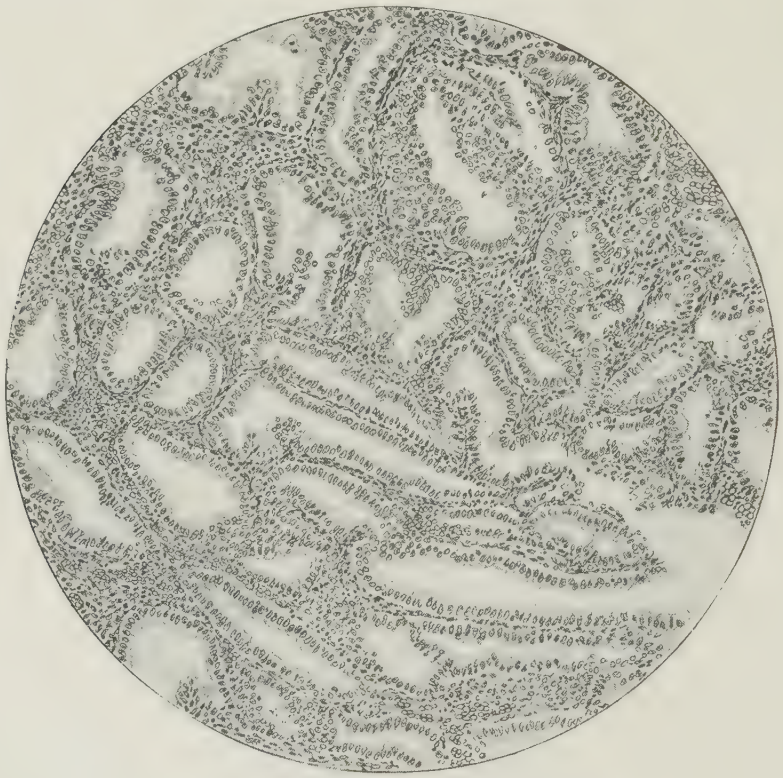

FIG. 69.—GLAND HYPERTROPHY.
The glands have only thin strands of stroma between them.

of the blood-vessels and by an edematous exudate in the spaces between the cells, while the glandular acini are longer and arranged in spiral forms. This process begins shortly before the menstrual flow, reaches its height during the flow, and then gradually subsides, to be repeated at the next catamenial period. The premenstrual and postmenstrual hypertrophy is, therefore, physiologic and common to a greater or less degree to all menstruating endometria. (See also page 24.) The hypertrophy may, under certain conditions, be permanent or excessive, and it must then be regarded as pathologic, though it does not necessarily cause symptoms. When the hypertrophy becomes extreme the mucous

membrane is thrown into folds of varying size. This process is called polypoid gland hypertrophy. An extreme form of the process shows great thickening of the endometrium, and the glands, besides being long and spiral, branch out and exhibit a true hyperplasia. This type, when pronounced, is called adenoma of the endometrium, and is sometimes difficult to distinguish from adenocarcinoma.

FIG. 70.—GLAND HYPERTROPHY WITH ENDOMETRIAL POLYP.

The glands, however, preserve their type and do not tend to dip into the muscular tissue of the uterus.

It may be said in general that the endometrium becomes thickened under conditions of prolonged hyperemia or passive congestion of the genital organs. These conditions are furnished physiologically by the menstrual flux, as we have seen. Pathologically, the hypertrophy may be the result of misplacements, pelvic inflammation, all decidual processes, repeated abortions, extra-uterine pregnancy, masturbation, excessive venery, etc. Sometimes extreme forms of

gland hypertrophy of the polypoid and adenomatous type exist apparently as an independent disease, the etiology of which is obscure.

Gland hypertrophy, as a condition secondary to pelvic congestion in a large percentage of cases, gives no symptoms. It may cause a moderate leukorrhea from the oversecretion of the endometrial glands, but this leukorrhea is not distinctive. Uterine pain and tenderness are often given as symptoms of gland hypertrophy, but these symptoms are more likely due to the pelvic condition to which the hypertrophy is secondary. The most important manifestation of gland hypertrophy is menorrhagia. Here, however, we meet with difficulty be-

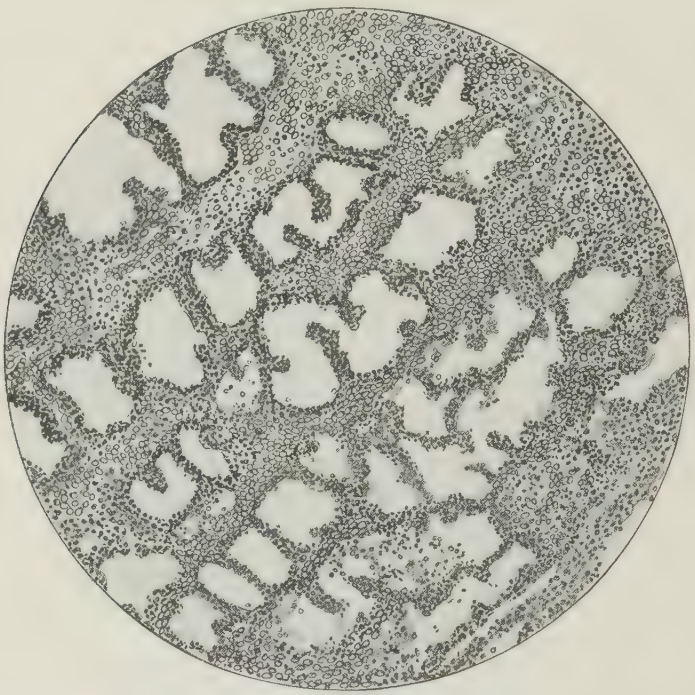

FIG. 71.—GLAND HYPERTROPHY.
The glands show the tortuosity frequently found, each gland being cut several times in the same plane of section.

cause of our defective knowledge of the causes of menorrhagia, and we cannot be sure that the hypertrophy is not the result rather than the cause of the abnormal bleeding.

In the polypoid and adenomatous types of hypertrophy, leukorrhea, menorrhagia, uterine pain and tenderness, and dysmenorrhea may appear as well-defined symptoms.

**Treatment.**—Since it has been learned that the hypertrophy of the endometrium is usually either physiologic or a secondary manifestation which does not of itself often give symptoms, there is not much to say concerning special

treatment of the endometrium. Attention is rather directed to the primary pelvic abnormalities.

When the extreme forms of polypoid or adenomatous hypertrophy occur the object of treatment is to control the menorrhagia, which may be very severe and depleting. Drugs, such as ergot, hydrastin, and hamamelis, are practically useless. Pituitrin is said by some recent writers to be of much benefit, especially

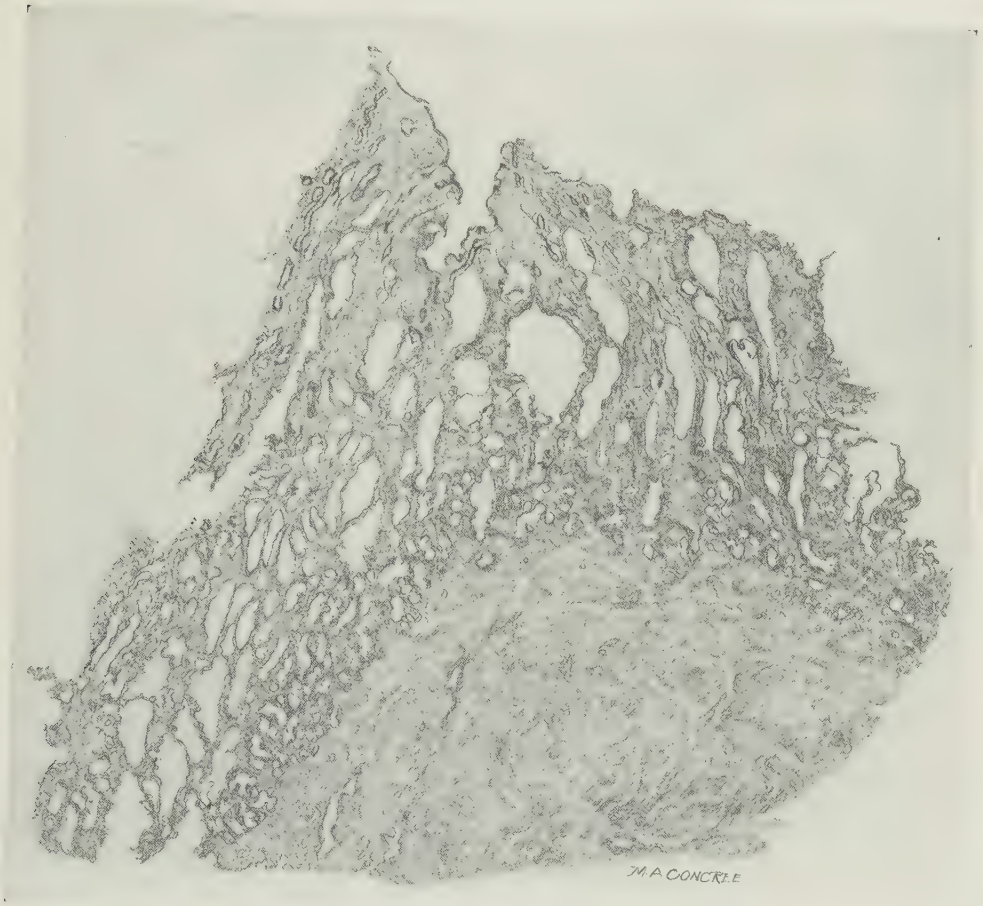


FIG. 72.—GLAND HYPERTROPHY (PERMANENT).
The dilatation of the glands is more irregular and greater than in premenstrual endometrium. (Low power.)

in the treatment of young girls. Cureting may diminish the bleeding temporarily, but in many cases the hypertrophied membrane re-forms rapidly and the cureting has to be repeated. Sometimes palliative treatment is of little avail, and in order to prevent the continued loss of blood a supravaginal hysterectomy must be resorted to. Radiation is coming to be of great value in these cases, but in young women it must be employed with caution and by expert hands to avoid destruction of the ovarian follicles, with consequent sterility.

## METRITIS

The term "metritis," like endometritis, is somewhat loosely used to designate various inflammatory and circulatory changes in the body of the uterus. Strictly speaking, it should be applied only to such inflammatory conditions as result from microbic infection. True metritis, when it does occur, is most commonly the result of severe puerperal infection, extending from the endometrium into the tissues of the uterine body. In the present days of improved obstetric technic puerperal metritis is not often met with. Outside of the puerperium infections of the metrium are rare. A few cases have been reported of gonorrheal metritis, while tuberculosis sometimes extends from the endometrium to the deeper layers of the uterine body.

Primary and secondary syphilitic lesions of the uterus have, according to Gellhorn, never been met with, but he records a few instances of gumma in the uterine wall. He considers that the uterus is relatively immune to syphilis. Other authors, notably C. C. Norris, have reported cases of "syphilitic metritis" manifested by bleeding. Norris performed a hysterectomy in his case. The uterus showed an abnormally soft consistency. The chief histologic characteristic was a universal angiosclerosis appearing in both the myometrium and endometrium. The endometrium and upper layers of the myometrium showed a chronic inflammatory reaction.

The **treatment** of infectious metritis belongs, for the most part, to the realm of obstetrics. It is primarily conservative and expectant. If the uterus contains infected and decomposing material, it is removed, but deep curetage is dangerous. Extreme cases sometimes require rapid total hysterectomy with drainage of the pelvis.

## INFLAMMATIONS OF THE OVARY

The subject of oöphoritis (or ovaritis) is at present in a state of some confusion, there being no unanimity among writers as to the classification of the various inflammatory processes of the ovary or to the clinical interpretation of many of the anatomic changes that take place in the ovarian tissue. We are obliged, therefore, to be somewhat arbitrary in treating the subject, and shall classify inflammations of the ovary simply under the headings of infectious oöphoritis and interstitial oöphoritis.

By "infectious oöphoritis" is meant those conditions of the ovary which result from the invasion of pathogenic microörganisms. It includes both the acute and chronic stages of the infectious process.

By the term "interstitial oöphoritis" is included a considerable number of somewhat vaguely understood degenerative conditions, manifested both in the stroma and epithelial structure of the ovaries, and resulting from constitutional disturbances, old inflammatory processes, or circulatory changes. Interstitial

oöphoritis is, therefore, not a true inflammation in the sense of being an infection of microbic organisms.

## INFECTIOUS OÖPHORITIS

Of the direct infections of the ovaries, that from puerperal sepsis is the most common, the streptococcus being the most frequent invading organism. The way by which the ovaries are attacked is usually from a pelvic peritonitis. In this way the ovarian surface is first implicated by contact with the inflamed peritoneum. In most cases the albuginea acts as an efficient barrier to prevent the organisms from breaking through into the parenchymatous tissue of the ovary, so that the process remains one of perioöphoritis. In severe cases, however, the infection may enter the ovary and cause an acute suppurative oöphoritis. Cases of this severity are usually fatal, but if the patient recovers the ovaries become involved in dense adhesions, often harboring chronic abscesses, until the infectious process gradually dies out or surgical operation intervenes. In such cases the ovaries are in a condition of true chronic oöphoritis.

Infection from puerperal sepsis may enter the ovaries by other ways than through the surface epithelium and albuginea. Sometimes the invasion may be by the route of the cellular tissue, from the parametrium through the hilus of the ovary into the ovarian stroma. According to Gebhard, the infection may reach the ovaries from a septic puerperium by the way of the parametrial blood-vessels as a result of septic thrombosis.

Outside of the puerperium the greater number of infections of the ovary are the result of gonorrhea. As has been pointed out in the section on that subject, the surface of the ovary may become involved in the general peritonitic process accompanying gonorrheal salpingitis, or the inner structure of the ovary may become involved in suppuration by the passage of infection from the ostium of the tube through the ruptured opening of a corpus luteum or even of an atretic follicle. In this way, as was shown, are formed the tubo-ovarian abscesses. These compound abscesses harbor the invading organisms longer than does a simple pyosalpinx, so that the disease is more severe, longer in duration, and requires more radical surgical treatment.

Tuberculosis may infect and include the ovary in a general suppurative process, extending from the tube in the same manner as gonorrhea. Miliary peritoneal tuberculosis may affect the surface of the ovary, but rarely, if ever, invades the ovarian stroma through the epithelial covering and the protective albuginea layer, though occasionally it may enter the opening of a ruptured follicle. Isolated tuberculosis of the ovary, of which a few cases have been reported, is the result of hematogenous infection from a distant focus, as has been shown in the section on Tuberculosis (*q. v.*).

The ovary in the form of an ovarian tumor may become infected as a result of torsion and adhesion to the intestine, from which, as a result of necrosis, organisms, usually the colon bacillus or some member of the staphylococcus

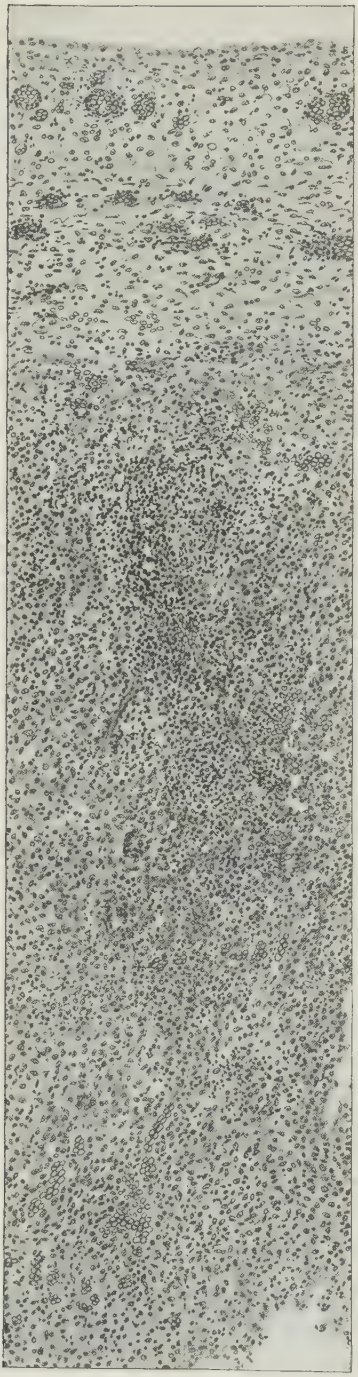

Fig. 73.—Tuberculous Ovary.

group, convert the cyst into an abscess. The surface of the right ovary sometimes becomes infected secondarily to acute appendicitis, especially in young girls.

Infectious oöphoritis sometimes results in intra-ovarian hemorrhages with the formation of blood-cysts, a subject which is discussed more fully in the section on Ovarian Tumors.

Chronic infectious oöphoritis represents the part taken by the ovaries in a general pelvic inflammation, and can hardly be regarded as a disease by itself. The symptoms from this condition are due to immobilizing peritoneal adhesions, and the special effect on the ovaries cannot be clinically distinguished.

Chronic infectious oöphoritis may be associated with or be converted into the interstitial type.

### INTERSTITIAL OÖPHORITIS

Interstitial oöphoritis is a subject which we must treat somewhat apologetically, including as it does a number of conditions the pathogenesis of which we have only an incomplete knowledge.

As stated above, interstitial oöphoritis does not represent an infectious process, but rather one of tissue degeneration.

In the earlier stages there is a general increase in the size of the organ. The interstitial elements are hypertrophied. There is a hyperplasia of the stroma cells without loss of their distinctive structure and also a well-marked thickening of the albuginea. An acute stage has been described in which are seen clusters of small round cells near the blood-vessels, and sometimes an edema pervading the lymph-spaces between the stroma cells.

In association with the changes in the interstitial tissue are practically always seen signs of degeneration in the parenchyma. There is marked diminution in the number of primordial follicles and an abnormal tendency to atresia and cyst

formation of the riper follicles ("small cystic degeneration"). In addition to the above findings there can usually be seen a thickening of the vessels in the medullary zone of these ovaries, so that they appear as hyaline masses, indicating a tendency to obliterating arteritis. Later stages of the process may exhibit an excessive cyst formation, in which usually one cyst develops at the expense of the others, and converts the ovary into a cystoma of greater or less size. (See Tumors of Ovary.) The cyst formation, according to Gebhard, is the result of an inability of the follicles to burst on account of the resistance of the dense albuginea layer, and represents a thwarted physiologic function. In other cases the interstitial elements undergo a sclerotic change, the parenchymatous portions disappear, and the ovary shrinks into a small fibrous, atrophied structure resembling that of old age.

The **etiology** in some cases is quite clear, while in others it is entirely obscure. Ovaries that have long been buried in adhesions often exhibit interstitial oöphoritis. This process, though the secondary outcome of a previous infection, must, nevertheless, be regarded not as inflammatory, but as an indication of degeneration resulting from interference with the circulation and normal function of the ovary. Degeneration of the ovaries sometimes occurs after acute infectious disease like typhoid, septicemia, small-pox, cholera, scarlet fever, and severe intoxications, such as are caused by phosphorus, arsenic, etc. The degeneration may be so complete as entirely to destroy the function of the ovaries, with consequent amenorrhea and sterility. Here the process is one which the ovaries share with certain other organs of the body after such maladies, and is not an infection, but a form of local degeneration. In lactation atrophy and premature senility a like change occurs in the ovaries. Other etiologic factors commonly supposed to produce ovarian degeneration have their basis in circulatory disturbances. Of these may be mentioned chlorosis, harmful influences during menstruation, such as exposure to cold or violent physical exertion, incomplete involution of the uterus after childbirth, circulatory changes from chronic heart disease, sexual irritation from masturbation or imperfect coitus, extra-uterine pregnancy, and, finally, the influence of pelvic tumors, especially of uterine fibroids. Undoubtedly, oöphoritis is sometimes found associated with all of these conditions, but in our present state of knowledge a definite causal relationship between the two must be accepted with reservation.

The **symptomatology** of infectious oöphoritis is identical with that of pelvic inflammation, to which the reader is referred in the chapter on Gonorrhea.

With regard to the symptomatology of interstitial oöphoritis ideas have within recent years undergone a considerable change. We now know that atresia of the follicles is physiologic, and that a certain degree of small cystic formation is to be found in practically all normal ovaries during the menstruating period of life, and that the process does not cause pain. Nor is pain in the ovary itself caused by an abnormal degree of cystic degeneration, even to the formation of a retention cystoma. If, however, adhesions are present, or

there is torsion of the enlarged ovary or engorgement of the broad ligament veins, pain is in evidence. Moreover, sclerosis of the ovaries does not of itself cause pain. Old women have sclerotic ovaries, but do not suffer pain from them. It is probable that most cases of so-called ovarian pain result from peritoneal adhesions, varicosities in the broad ligaments, torsion of the ovarian vessels, possibly the drag of a heavy organ on the ovarian ligaments. Of these causes peritoneal adhesions is the most frequent. They cannot always be detected even by the most expert examination, and this leads frequently to such diagnoses as "ovarian neuralgia."

Another common fallacy is that cystic degeneration causes "reflex" nervous symptoms, such as hysteria, genital psychoneuroses, etc. This subject is discussed in the section on Neurology.

Interstitial oöphoritis is a not infrequent cause of sterility, as would be expected from the pathology of the affection.

The **treatment** of infectious oöphoritis is that of pelvic inflammation.

The treatment of interstitial oöphoritis depends on the associated condition which causes the symptoms. It cannot be diagnosed except in the case of abnormal cyst formation when surgical interference is indicated, the operation being conservative (resection) or radical (oöphorectomy), according to the size of the cyst. The resection of ovaries which show moderate cystic degeneration is a useless and often harmful procedure.

For cases of premature sclerosis and atrophy, ovarian extract is indicated.

### SYPHILIS OF THE OVARY

Syphilitic oöphoritis, tertiary sclerosis of the ovary, and ovarian gumma have been described, but according to Gellhorn and Ehrenfest no positive proof has been adduced that such changes were due to a local syphilitic process. They do not accept as evidence of a syphilitic ovarian lesion that in some syphilitic patients an amenorrhea or menorrhagia disappears after specific treatment. Spirochetes have never been demonstrated in the ovaries of adults.

## PARAMETRITIS AND PELVIC CELLULITIS

**Anatomy of the Pelvic Cellular Tissue.**—Lying beneath the pelvic peritoneum is a complicated intercommunicating space filled with a somewhat loose connective tissue, which is termed the "pelvic cellular tissue." This tissue partly surrounds all the organs of the pelvis. In it are embedded the ureters and the large vessels of the pelvis. In some places the cellular tissue is loose and filmy, a characteristic which originally gave the structure its name. In other places it is denser and contains smooth muscle-fibers. These thickened portions constitute the so-called ligaments of the uterus. The presence of muscular fiber is especially well marked along the uterine vessels near their entrance into the uterus, and gives the tissues at these points such firm supporting strength that they are designated the cardinal ligaments of the uterus.

Certain parts of the pelvic cellular tissue are characterized by special names from their relationship to various organs. Thus, that which is in contact with the uterus is called parametrial; that near the bladder, paracystic, and that near the rectum, paraproctal. Inflammations of these portions have the corresponding names of parametritis, paracystitis, paraproctitis, etc., while a general term including any form of inflammation of the tissue is "pelvic cellulitis."

The parametrial cellular tissue surrounds that portion of the uterus and cervix that is included in the pelvic diaphragm. The most important part of it lies at the bases of the two broad ligaments. It is enclosed by the leaves of the broad ligaments above and merges into the wall of the vagina below. In front there is a certain amount of delicate parametrial tissue between the bladder and its reflection on the anterior wall of the uterus. Behind, the peritoneum is bound closely to the posterior wall of the uterus, cervix, and vagina, so that there is little parametrial tissue in evidence.

In close connection with the parametrium is the cellular tissue about the bladder. It communicates in front of the bladder with the very loose fibers which occupy the so-called prevesical space or space of Retzius. Behind, the parametrium is less directly connected with the paraproctal cellular tissue in relation with the rectum. Between the rectum and vagina is found a layer of the tissue which communicates behind with a layer between rectum and sacrum. The subperitoneal cellular space reaches out laterally to the abdominal wall and posteriorly to the lumbar vertebræ.

Besides these comparatively direct communications, the tissue ramifies to other areas by narrow channels. Thus, it connects with the fat of the ischiorectal fossa by a small opening between the ischiococcygeus and the levator ani muscles. With the interstitial connective tissue of the lower extremities a communication exists through the crural arch along the crural vessels. A similar connection with the gluteal region is found through the greater ischiadic opening; also one with the inguinal region along the round ligament.

The area occupied by the pelvic cellular tissue must be regarded as a space through which infection may spread along lines of least resistance, or which extravasations of blood may permeate, or which tumors may readily dissect in the process of growth. The pathology of the cellular tissue is, therefore, classified into three phases—inflammation, hematoma, and tumor formation. The first two phases will be discussed in this section, the third is treated in the section on Tumors.

## INFLAMMATIONS OF THE PELVIC CELLULAR TISSUE

Infection of the cellular tissue occurs as a microbic invasion through lymph-channels, the most common seat of infection being the parametrium. The inflammatory process may remain localized or it may spread to other parts of the cellular space. It usually affects the overlying peritoneum, the inflam-

mation of which may be confined to the local area or spread in the form of a general peritonitis. The infectious process may reach no further than the stage of infiltration, or it may progress to suppuration of the most extensive character. Just as there is a wide range in the pathologic aspects of cellulitis, so, in the clinical picture, the disease may vary from one of mild insignificance to one of rapid fatal termination.

Pelvic cellulitis practically always implies a thrombosis of the veins which pass through the tissue involved. In a parametritis the thrombosis may be confined to the branches of the hypogastric and internal spermatic veins, but it may extend to the internal iliac, common iliac and crural veins, and even to the vena cava.

The relationship between the inflammatory process and the formation of thrombi is not a constant one. Extensive thrombosis is frequently seen in connection with slight evidence of parametrial infiltration and vice versâ. The most important secondary results of thrombosis are pulmonary embolism and the edema of the lower extremity in cases where the crural vein is involved (phlegmasia alba dolens—milk leg).

If the inflammatory process of the cellular tissue progresses to local suppuration the abscess may break through into neighboring organs, most commonly the vagina, rectum, or bladder, occasionally into the cervical canal.

The healing of cellulitis results in dense scar formation, which may cause serious dislocation and immobilization of the pelvic organs.

The interest in cellular inflammation centers chiefly in that of the parametrium. Parametritis is most commonly an obstetric disease, infection resulting from some trauma of the cervix by which pathogenic organisms are introduced, or from a puerperal septic condition of the endometrium through the lymph-channels of the uterine wall. The obstetric aspects of parametritis cannot be treated here.

From the standpoint of gynecology, parametritis is most commonly seen as a complication of pelvic operations. The operation most frequently followed by this affection is that of hysterectomy for pelvic inflammation, in which there exists some active infectious process in the subperitoneal cellular tissue. Just as cellulitis may involve the overlying peritoneum, so a pelvic peritonitis may also implicate the underlying cellular tissue. Removal of the pelvic organs sometimes lights up the infection of the cellular tissue, and local sepsis, usually in the parametrium, results, which if not well provided for by competent drainage may cause the backing up of a pelvic abscess. Postoperative cellulitis or parametritis may follow any pelvic operation in which the cellular tissue is infected during the operation; for example, the parametrium may be infected from a septic endometrium by careless handling of the uterus during a hysterectomy operation. A parametritis may also result from a parametrial hematoma that later becomes infected.

Minor operations, such as dilatation and curetment, the use of the sound,

and operations on the cervix, if performed without aseptic precautions have been known to cause parametritis. Even foreign bodies in the vagina, which cause ulceration and local infection, may transmit the inflammatory process to the parametrium through the lymph-channels. Inflammation of the parametrium from these latter causes are, however, rare.

An important factor in the causation of gynecologic parametritis is the infection from necrotic tumors of the uterus and cervix, such as sloughing fibroids and cancer. Cancer of the cervix is especially prone to infect the parametrium, harboring, as it always does, the most virulent organisms. This point is of special clinical importance, because it is often difficult to determine by palpation whether a parametrial infiltration is due to the extension of inflammation or of cancer, and on this point often rests the decision as to whether or not the case is operable. It is possible for the parametritis following the infection of cancer of the uterus to extend to the pelvic peritoneum and cause a local or even a general peritonitis.

Rare causes of parametritis are the spreading of infection from appendicitis and the invasion of actinomycosis.

Wertheim gives as an unusual cause of parametrial inflammation the deep invasion of the gonococcus through the peritoneum. An actual gonococcal parametritis is probably rare, nevertheless the cellular subperitoneal tissue is very frequently found edematous and inflamed during operations for pelvic inflammation of gonorrheal origin. Doubtless the invasion of the cellular tissue is the result of other organisms which so often complicate all gonorrheal infections.

Extensive tuberculosis of the pelvis is sometimes attended with deep infiltration of the cellular tissue.

Syphilitic pelvic cellulitis is a rare but well-defined lesion, authenticated by Gellhorn. It appears as a diffuse gummatous infiltration of the pelvic cellular tissue, usually diagnosed as malignancy. Specific treatment causes rapid disappearance of the local condition.

**Symptoms.**—The chief symptom of postoperative parametritis is pelvic pain, usually more on one side than the other. On account of the proximity which the process has to the bladder, and the usual extension to the paracystic cellular tissue, there are, as a rule, symptoms of irritable bladder with the presence of a mild cystitis. There is always some elevation of temperature, and if suppuration occurs there is a marked rise in the leukocytosis and an increase of local symptoms.

Postoperative parametritis, though it may progress to a fatal termination, is usually not a particularly dangerous complication, though it may prolong the convalescence for many weeks. If there is suppuration, and evacuation of the pus is brought about either spontaneously or by secondary operation, a rapid cure usually results. Cases in which the parametrial infection is of the infiltrating, non-suppurative type, though milder in their course, have a tendency to

recurrence one or more times weeks or months after subsidence of the first attack.

A very chronic form of parametritis, complicating pelvic inflammation resulting from salpingitis and adhesions in the posterior culdesac, is often met with during pelvic operations. The cicatricial tissue caused by this complication is exceedingly dense, and greatly increases the difficulty and danger of the operation. This condition is almost invariably met with when a previous posterior colpotomy has been performed for the evacuation of a tubal abscess, and it is for this reason that the latter operation is to be avoided excepting as a life-saving measure.

The chronic form of parametritis is also frequently encountered during the extended operation for cervical cancer, a complication which makes the isolation of the ureters and uterine vessels extremely difficult. Patients who have had radium treatment usually show the cicatricial form of parametritis to a greater or less extent.

The cicatricial type of chronic parametritis is termed "parametritis atrophicans" (Freund) and "parametritis posterior" (Schultze).

Postoperative parametritis is, as a rule, easily detected by digital examination. The cervix is entirely immobilized, and there is a hard board-like feel to the surrounding tissues which is entirely characteristic, and simulated only by the infiltration of malignant disease or by a parametrial hematoma. The indurated area is situated on one or both sides of the cervix, reaching to the pelvic wall, very often extending around to the front if the paracystic tissue is involved. It is usually tender. Suppuration is indicated by increased swelling and softness of the mass, associated with rise in the leukocyte count and aggravation of the constitutional symptoms.

A **differential diagnosis** between infectious parametritis and postoperative parametrial hematoma cannot always be made. Hematoma is, as a rule, less tender, constitutional reaction is less marked, and the leukocyte count is lower or absent.

Parametritis associated with cancer of the cervix, if of the chronic exudative type, cannot well be differentiated from infiltration of the malignant disease. If the process is more acute the patient has well-defined symptoms of pelvic inflammation. Such patients should not be operated on, nor should they receive radium treatment, which not only tends to aggravate the inflammatory process, but also intensifies the malignity of the cancerous disease. The use of radium not infrequently of itself produces an inflammatory reaction in the parametrium, which makes radical operation immediately following radium treatment exceedingly dangerous as regards postoperative sepsis (see also Radium Treatment of Cancer).

The **treatment** of postoperative parametritis is usually palliative because in most cases the process tends to absorption rather than to suppuration. The best treatment is rest in bed with frequent hot vaginal douches. Absorption

under treatment may take place in a few days, but may require several weeks, sometimes months. If suppuration occurs the abscess must be opened and evacuated, usually by a vaginal incision. Sometimes a postoperative parametrial abscess may be evacuated by careful dilatation of the canal of the cervical stump. If there has been vaginal drainage, enlarging the drainage opening may be all that is necessary.

Extensive dissecting abscesses may require more than vaginal drainage. In some cases they may best be opened by an incision near the groin, through which the peritoneum is stripped back without entering the abdominal cavity, so that the abscess may be evacuated extraperitoneally. It may even be necessary to attack the disease by incision in the gluteal, perineal, or ischiorectal regions.

Septic cellulitis may follow pelvic operations and originate in other parts of the cellular space than the parametrium. We have seen two cases of extensive cellulitis in the lateral wall of the abdomen and pelvis follow shortening of the round ligaments by the Mayo method. Suprapubic operations on the bladder may result in sepsis of the cellular tissue and cause a dissecting abscess reaching to the lumbar region. Other instances might be enumerated. The treatment of these abscesses can sometimes be carried out successfully by conservative measures, but in general it is best to open them by the most advantageous route.

## PARAMETRIAL HEMATOMA

Parametrial hematoma, though not an inflammatory disease, is treated here because of its close association with parametritis. The hematoma results from some trauma which has caused a hemorrhage into the parametrial tissue. Being partially confined, the extravasated blood soon clots and forms a dense tumor. The tumor may be restricted to the parametrial region, or it may dissect its way through the cellular space upward as far as the region of the kidney, forming an immense tumor. Severe parametrial hematomata are most frequently seen as an obstetric complication, following laceration of the cervix into the broad ligament, with rupture of veins in the parametrial tissue.

In gynecologic practice extensive hemorrhages into the cellular tissue may occur during the enucleation of intraligamentous or postperitoneal growths. The accident is discovered by the appearance of a rapidly increasing tumor in the flank, with evidences of shock on the part of the patient. Such a hemorrhage may be fatal, or the blood may soon clot and the patient be little the worse for the accident.

Postoperative parametrial hematoma is by no means uncommon, especially after supravaginal hysterectomy. The complication is due to incomplete hemostasis and postoperative oozing of blood into the parametrial space. Frequently it entirely passes notice unless the patient receives a vaginal examination before leaving the hospital. In other instances the convalescence lacks

smoothness. The temperature continues to be slightly elevated and the patient experiences some pelvic discomfort. Sometimes the patient within a few hours after operation passes through a temporary period of shock with very rapid pulse, for which the attendants are unable to account.

Vaginal examination of a patient with parametrial hematoma reveals a hard board-like induration adjacent to the cervical stump and completely immobilizing it. The induration may extend forward into the paracystic region; sometimes it extends to the pelvic wall.

The hematoma is usually slow in absorbing, and may remain weeks or months in the pelvis before its disappearance. Sometimes it becomes infected and converted into a parametrial abscess.

The **treatment** of parametrial hematoma is primarily prophylactic, and consists in taking extreme care in ligating all bleeding points during the operation of hysterectomy, or, better still, to perform the operation in such a way that there will be no bleeding. The maneuver shown on page 770, of closing the peritoneum over the cervical stump in such a way that there will be opportunity for drainage back into the peritoneal cavity of slight oozing, is a good preventive, for blood is much more readily absorbed from a peritoneal surface than from the parametrial tissue.

When a hematoma has been formed surgical interference is practically always contraindicated. The treatment should be conservative, as in the exudative form of parametritis, and consists in rest and the frequent application of hot douches. If the hematoma becomes infected the treatment then becomes that of suppurating parametritis.

## URETHRITIS

**Acute urethritis** is almost exclusively the result of gonorrheal infection, and has been described in the chapter on Gonorrhea (*q. v.*). The infection is usually primary and appears after a short incubation period. There is at first discomfort, then intense burning, on micturition. The meatus becomes swollen and hyperemic, while the entrances to the ducts of Skene's glands become red and swollen. A thick yellow pus appears, and occasionally there is bleeding from ulceration or fissure of the urethral membrane. The acute stage of the disease passes quickly. The pus becomes thinner and more scanty, and the disease either heals spontaneously or passes on into the chronic stage, which may last for months or years. Gonorrheal urethritis may come and go without producing noticeable symptoms. (See also section on Gonorrhea.)

**Chronic urethritis** may be the end-result of an acute gonorrheal attack, or the gonorrheal infection may be of the chronic type from the first. Chronic urethritis may also be primarily the result of infection from other organisms than the gonococcus, those most commonly found being the colon bacillus and the staphylococcus. It is, however, very difficult to say in a given case whether the original infection was or was not gonococcal, for in a chronic urethritis which

remains from an acute gonorrheal attack various pathogenic organisms may be found without the presence of the gonococcus. Primary colon bacillus urethritis doubtless occurs, but its frequency is problematic.

Chronic urethritis is localized in certain portions of the urethra, not often involving the entire canal.

The principal symptom of chronic urethritis is burning on micturition. Its long and intractable persistence usually has a deleterious effect on the general nervous system, especially if the patient thinks herself infected with a venereal disease.

Treatment is by the local application of 5 per cent. silver nitrate to the urethra, and requires time and patience.

**Periurethral abscess** is usually secondary to inflammation of Skene's glands, and occupies the anterior vaginal wall in its lower third. It communicates by a small opening with the urethral canal, into which it intermittently discharges. The abscess contents may change in time to a thin or serous character and the condition become painless, so that the swelling may be mistaken for a vaginal cyst. The diagnosis can be made by the ability to evacuate the tumor into the urethral canal.

The treatment is removal of the abscess or cyst sac by careful dissection. The opening into the urethra must be treated by the methods used for vesical and urethral fistula.

**Stricture of the urethra** is not a common affection among women. It is usually the result of gonorrhea, but may be due to the injuries of childbirth. Urethral stricture is not infrequently seen in women with marked genital atrophy, the process simulating that which takes place in the cervix with consequent atresia.

Other causes given for urethral stricture are syphilis, lupus, congenital malformation, neoplasms of the urethral wall, kraurosis vulvæ, healed ulcers from typhoid fever, and local trauma.

The symptoms are difficulty and discomfort in urination.

The treatment is usually simple, and consists either in gradual dilatation under cocain or rapid dilatation under full anesthesia. The severe cicatricial form of stricture, which is rare, may require annular dissection of the scar tissues.

Kelly recommends electrolysis, by the method of Newman, as a routine method of treating intractable stricture.

## CYSTITIS

Cystitis, in its strictest sense, relates to an infection of the bladder wall by pathogenic organisms. The existence of a cystitis is demonstrated by the presence of infectious bacteria and the products of inflammation in the urine. The mere presence of bacteria in the urine does not constitute a cystitis, for it has been shown that quantities of germs may be introduced into the bladder

without harmful effect, while it is a common occurrence that patients with septic processes in the kidneys for long periods of time pass urine that is loaded with bacteria without infecting the bladder.

In order to create a cystitis, bacteria must find a point of entry into the tissues of the bladder wall through the lining epithelium. This entrance may be gained either by a lesion of the bladder wall or by some condition in which there is a lessened resistance on the part of the mucous membrane. Injuries of the bladder mucosa may be caused by traumatism during operations, or instrumentation, or by unskilful catheterization. The lesion itself does not constitute a cystitis, but prepares the way for infectious organisms. Invasion of the bladder by bacteria may result from the trauma of vesical stones, or from inflammatory processes of neighboring organs, which, by contact and adhesions, involve the bladder wall. The resistance of the bladder mucosa may be lowered by the irritation of chemical substances excreted in the urine, such as results from the ingestion of cantharides, asparagus, fermented liquors, etc., or it may be caused by the long retention of urine from cystocele or stricture from pelvic tumors. Severe colds and physical exhaustion also lower the resistance of the bladder to infection. Conditions of lowered resistance do not necessarily lead to cystitis, but they merely predispose the organ to infection. They are probably an infrequent etiologic factor in the disease.

The irritation of ammoniacal urine is a very definite cause for bacterial infections, the chemical change being usually brought about by bacterial action. A very great number of bacteria have been named as excitants of cystitis, the most important being the Coli communis, proteus Hauser, streptococcus, staphylococcus, pyocyaneus, tubercle bacillus, typhoid bacillus, and rarely the gonococcus. There may be combined or mixed infections, especially in the presence of the tubercle bacillus. The reaction differs also with various exciting organisms, the urine, for example, being alkaline with the proteus Hauser and acid with the staphylococcus or colon bacillus infections.

**Routes of Infection.**—The chief route of invasion by infectious organisms is through the urethra. It has been a matter of considerable debate as to whether spontaneous ascending infection takes place through the urethra. This has been generally denied in the male, but thought to be possible in the female on account of the shorter and less complicated urethral canal. It has been pointed out, however (Stoeckel), that the entrance of bacteria to the bladder is conditioned on the integrity of the sphincter vesicæ muscle, which under normal conditions is as efficacious in women as it is in men. In women, on the other hand, there is far greater opportunity for injury to the muscle, such as results from childbearing, cystocele, and general conditions of prolapse, so that it much more frequently becomes relaxed and affords an avenue of entrance for bacteria from the urethra and vestibule.

The most common means of infecting the bladder through the urethra is by catheterization. This may be accomplished by carrying organisms into the

bladder on an unclean catheter, or it may be done by transferring bacteria from the vestibule and meatus on a catheter that has been properly sterilized. Postoperative cystitis following catheterization and introduction of organisms depends, to a great extent, on the amount of trauma done to the bladder during operation. Aside from the actual accidental tearing or cutting, the bladder wall may be injured in a variety of ways not always appreciated by the surgeon during a difficult pelvic operation. Kelly calls attention to the furrowing and infiltration of blood seen in the mucosa of the posterior wall following the method sometimes used of stripping the bladder by gauze dissection from the cervix and vagina during a hysterectomy operation. The careless clamping and tying of vessels in the bladder wall may cause local injuries or congestions, which sometimes develop minute ulcerations or desquamations of the lining epithelium resulting from extravasations of blood (Stoeckel). These may serve as ports of entry for bacteria introduced by catheterization.

Cystitis is especially common after labor because of the frequency of injury to the bladder by the passage of the head and the necessity for catheterization. It is noticeable that patients who have suffered from postpartum cystitis are especially prone to develop the condition after later labors or pelvic operations which involve the bladder, such as hysterectomy or anterior colpoplasty.

It has been shown that the hyperemic state of the bladder wall during childbirth is especially favorable to the growth of invading organisms, as are all conditions of pelvic congestion, such as may result from menstruation, large pelvic tumors, adnexal disease, masturbation, and too frequent coitus.

Another means of infection of the bladder is by the descending route from the kidneys, though, as has been stated, pus in the urine from infected kidneys may exist for a long time without causing cystitis.

There seems to be no doubt that infection may be carried to the bladder wall by the route of the blood circulation—so-called hematogenous infection. Undoubtedly, some of the cases of colon cystitis have thus been contracted from congestion and stasis of the intestines. The cystitis that sometimes follows acute infectious diseases, like typhoid, malaria, and influenza, in which the specific organism can be demonstrated in the urine, undoubtedly results from a hematogenous infection.

There seems to be no question also that micro-organisms may reach the bladder through the lymph-channels, either from the large intestine or from infections of the pelvic genital organs.

Cystitis may also be caused directly by the rupture into the bladder cavity of a tubal abscess or dermoid cyst or purulent diverticulitis.

A somewhat frequent secondary inflammation of the bladder is that which results from a parametritis, the organisms probably entering the bladder wall through the lymph-channels. This is seen both in puerperal sepsis and in the postoperative parametritis that occasionally follows hysterectomy operations, especially those for extensive purulent pelvic inflammation.

The spontaneous infection of an ascending gonorrheal urethritis is probably rare. The organism has been demonstrated in acute cystitis by Wertheim and Young, so that gonorrheal cystitis unquestionably exists. It is probable, however, that in most cases the disease is transferred to the bladder by ill-considered instrumentation or treatment of the urethral canal.

**Pathology.**—The mucosa of acute cystitis has a characteristic appearance of general reddening, injected branching blood-vessels, and edematous thickening of the membrane, with ecchymoses and erosions, seen most commonly at the trigonum. The inflammatory process, as a rule, does not affect the entire bladder wall equally, the floor, including trigonum and fundus, being the chief seat of the infection. According to Kelly, in the acute stages there is comparatively little loss of epithelium. Severe inflammatory processes may, however, take place, with very general necrosis of the epithelial layers, forming so-called croupous or diphtheritic membranes, or even reaching the muscularis and causing gangrene of the bladder. Gangrene results in sloughing of the inner lining of the bladder, with consequent thinning of the wall and possible rupture or extension of the inflammation to the peritoneum (Küstner). Healing of this condition results in great shrinking of the organ. A special appellation, used by Kelly for conditions of sloughing of the bladder wall, is *exfoliative cystitis*.

In the chronic stages of cystitis the changes are very numerous. Certain proliferations of the epithelium may take place, producing granular, warty, or polypoid elevations of the surface, to which special names, as cystitis vegetans, verrucosa, and polyposa, have been given. Metaplastic conditions of the epithelium characteristic of leukoplakia and xerosis are seen which are said to lead to cancer of the bladder (Albarran). The proliferating papillomatous forms of cystitis can sometimes be differentiated with difficulty from true new-growth papillomata, the transition from one condition to the other being gradual. In some cases there occurs a dipping down or infolding of the mucous membrane, with the ultimate creation of gland-like inclusions. The epithelium lining these pseudoglands becomes modified, and resembles the mucosa of the intestinal tract. The inclusions may form cysts, which in the female bladder often break down, ulcerate, and become incrusted with calcium salts (Kelly). The gland inclusions are doubtless the original seat of adenocarcinoma of the bladder.

It has been pointed out (Zuckerkandl) that isolated cysts may occur in normal bladders, but that the condition is pathologic when they become multiple or diffuse. The affection has been termed *cystic cystitis* and *herpes vesicæ*.

Simple or solitary ulcer of the bladder occurs usually on the posterior wall, and resembles somewhat tubercular ulceration. The cause of simple ulcer is thought to be from local trophic injury to the bladder wall by thrombosis of a vein. Stoeckel has observed them after pelvic operations where vessels had been tied in the wall. These ulcers are sometimes made by inexpert cystoscopy.

The capacity of the bladder may, as a result of chronic inflammation, be-

come greatly diminished by a cicatricial change in the bladder wall, with consequent shrinking of the organ, or by a concentric hypertrophy of the tissues of the wall. The shrunken bladder is most commonly the result of neglected vesical tuberculosis, secondarily, as a rule, to tuberculosis of the kidneys. The wall is stiff and unyielding, neither dilatable to its full extent nor able to contract to its normal limits.

*Paracystitis* relates to an inflammation of the connective tissue about the bladder, the infection of which may have come from a cystitis or from a parametritis. Purulent paracystitis may extend for a long distance in the subperitoneal cellular tissue and may result fatally.

*Pericystitis* is an inflammation of the peritoneum covering the pelvic portion of the bladder. It may result from cystitis or from a general pelvic inflammatory disease, by which the adnexa or anterior wall of the uterus or intestines become attached to the bladder. As a rule, however, the anterior half of the pelvis is peculiarly free from infection in adnexal disease, so that the bladder is only occasionally involved.

**Symptoms and Course.**—The characteristic symptoms of *acute cystitis* are pain, dysuria, frequency of urination, and pus in the urine. The bladder is tender and sensitive to abdominal and vaginal palpation and to the passage of the catheter. The dysuria in cystitis is usually distinctive, in that the pain is severe just before micturition and is relieved by the act, that of urethritis being most severe during urination. The completion of urination is attended with tenesmus. If the affection is severe and there is great frequency, the condition of the patient may be one of almost constant strangury. The pain often radiates into the vagina, rectum, and legs. The symptoms are most distressing at night on account of disturbance of rest and sleep by the incessant need of micturition.

In the acute stages there is usually fever which may reach a considerable height. The fever recedes with the subsidence of the acute disease, but if after careful treatment it still remains elevated, one must search for other causes, especially an ascending infection to the kidney pelvis.

Acute cystitis under rest and proper treatment, as a rule, heals after various exacerbations, but it may exceptionally develop into the chronic form (Stoeckel).

Symptoms of *chronic cystitis* are, in general, the same as those described for the acute form, though less intensive, except in the cases of contracted bladder, when distressing symptoms may continue for long periods of time. Bleeding is comparatively rare in cystitis unless it is associated with stone or tumor formation.

A possible complication of cystitis is an ascending infection resulting in pyelitis or pyelonephritis. Occasionally the inflammation may extend to the peritoneum or paracystic tissue, or may send embolic thrombi into the circulation with the production of a pyemia.

The duration of chronic cystitis may be indefinite, resisting all forms of treatment and lasting for years.

The **diagnosis** of *acute cystitis* is not a difficult one, as the clinical picture is very characteristic, consisting of severe pain and frequent necessity of micturition, with distressing tenesmus, a sense of fulness and pressure in the pelvis, tenderness of the bladder region, rise of temperature, and presence of pus in the urine which is usually neutral or alkaline. A very similar picture is presented in acute gonorrheal urethritis which can, as a rule, be differentiated from

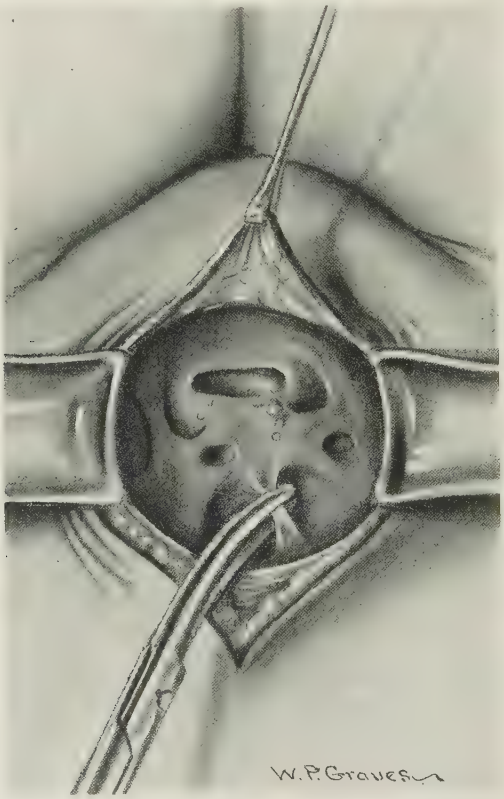


Fig. 74.—Unusual Result of an Exfoliative Cystitis, which has Caused Plastic Adhesions of the Bladder Wall, with Great Contraction of the Bladder.

The adhesions are being severed in order to give greater capacity to the bladder. Through the cystoscope the appearance was that of multiple diverticula. (Operation by Dr. F. A. Pemberton at Free Hospital for Women.)

cystitis by the appearance of gonorrheal pus exuding from the urethra and by the two-glass urine test, the second urine being clear in urethritis.

The diagnosis of *chronic cystitis* is a much less simple matter. The subjective symptoms are less characteristic and cannot always be distinguished from those that result from pressure or traction from affections of neighboring organs. The examination of the urine affords only incomplete evidence. The cloudy appearance of a urine that has not been freshly voided is misleading on account

of the possibility of urates or phospates or bacteria causing the cloudiness. If the freshly passed or catheterized urine is cloudy, the condition is pathologic. If pus is found by microscopic examination an inflammation is evidently present, but its location is not indicated, as it may come from an infection higher up. Washing out the bladder gives some information as to whether the condition is one of cystitis or pyelitis. In cystitis the wash-water soon returns clear, and will remain clear for some time, while in pyelitis there is an early reappearance of pus.

Though clinical observations give a more or less valuable clue to the nature and location of the disease, a definite diagnosis can only be made with the cystoscope. In acute cystitis cystoscopy is entirely contraindicated on account of the danger of aggravating the inflammation, but in chronic cystitis it is essential for diagnosis and often for treatment.

The cystoscope will reveal the presence or absence of an inflammation of the urethra, while a simple pyelitis may usually be determined by exudation of pus from the ureteral orifice, associated with a normal bladder wall. The changes of the bladder wall are numerous, as has already been stated, and consist chiefly of various grades of vascularization, from intensive infection of the blood-vessels to diffuse bright or dark red coloring of the tissues, in which the distinct outlining of the blood-vessels entirely disappears. The glistening appearance of the normal mucous membrane is lost and the surface appears dull. The mucosa from edema often has a puffy and granular character. The purulent secretion is either attached to the wall in shreds or floats freely in the fluid contained in the bladder.

In advanced cases defects of the epithelium take place, with consequent ulcers with irregular flat edges. These ulcers on healing cause sharp cicatricial ridges which interfere with the elasticity and contractility of the bladder wall.

The lesions of cystitis rarely occupy the whole of the bladder wall, but are, for the most part, confined to the floor of the bladder, trigonum, and fundus, the vertex being comparatively free from infection. As a rule, also, the inflammatory areas occur in scattered irregular patches, sometimes in spots or petechiæ.

**Prophylaxis.**—In the postoperative conduct of gynecologic cases cystitis may, to a great extent, be prevented by proper regard to catheterization. The use of the catheter should always be avoided if possible, but the fact remains that the majority of patients recovering from pelvic or plastic operations require one or more catheterizations. This must usually be done by the nurse, but if she is properly trained or instructed infections from the use of the catheter may be reduced almost to nil.

The following is the technic employed at the Free Hospital for Women: Under aseptic precautions the vestibule and meatus are thoroughly wiped with 1 : 1000 corrosive solution on sterile gauze. A glass female catheter with slight curve at the end is attached to a sterile fountain syringe containing 2 per cent. boric solution or sterile water, the receptacle containing the fluid being held a short distance above the level of the patient. When the catheter is about to be introduced into the meatus the solution is allowed to flow until the end of the catheter

reaches the bladder, when it is turned off and the rubber tube of the syringe is detached from the catheter. When the urine has been completely drained from the bladder the catheter is drawn gently out, with the thumb over the open end to prevent the dropping of urine as it is extracted. Every motion in introducing and withdrawing the catheter must be made with extreme gentleness so as not to injure the bladder mucous membrane.

The glass catheter is the best form. The surface is smooth and non-irritating and it can most easily be sterilized and kept sterile. Its special advantage over a rubber catheter is that it can be introduced by grasping it well away from the end, while a rubber catheter on account of its lack of stiffness must be taken in the fingers near the end of entrance, thus adding an element of danger of infection. Metal catheters have sharp edges at the openings and easily become rusted, so that there is greater danger of injuring the delicate mucous membrane of the urethra and bladder.

The **treatment** of *acute cystitis* is pre-eminently heat and warmth. The patient should be kept strictly in bed and applications of moist or dry heat kept over the bladder region. Moist heat is the most effective, and can best be applied with pads of wool soaked in hot normal salt solution, by which method the frequent changes are not likely to cause maceration of the skin, as is the case with cotton pads and plain water.

In order to relieve pain, codein or opium rectal suppositories are indicated, subcutaneous injections of morphin being avoided excepting in extreme cases.

Kelly calls attention to the importance of determining as soon as possible the exciting organism, showing that the treatment should be varied according to the kind of bacterium found. To quote Dr. Kelly:

"We are able here to distinguish five different forms of treatment, according as they are applied to one or other of these groups of infecting organisms: for example, when tubercle bacilli are found, the general practitioner may safely conclude at once that the trouble is quite certainly renal in its origin and surgical in its treatment. Gonococcal cystitis will disappear under the use of oil of copaiba or the oil of sandalwood. The colon bacillus and the typhoid bacillus are more affected by urotropin taken in doses of 3 to 15 or 20 grains four times a day, according to the toleration—big doses, if they do not irritate the bladder, are, as a rule, most efficient. The diphtheria bacillus (rarely found) calls for the administration of antitoxin. If the proteus is found and the urine is alkaline, give benzoic acid in doses of 10 to 15 grains to make it acid, and then follow this with urotropin. Staphylococci and streptococci also call for the use of urotropin."

A bland diet must be imposed in which alcoholic drinks and highly seasoned food is strictly prohibited. The patient is encouraged to drink large quantities of water, the numerous mild alkaline waters being especially recommended. When the more acute symptoms have subsided the best method of medication is the use of urotropin, cystogen, or helmitol, the efficiency of which depends on the liberation of formaldehyd in the urine. In order that the formaldehyd be freed it is necessary that the urine be strongly acid. It is, therefore, important to change the reaction of neutral or alkaline urines by the use of benzoate of soda (doses of 10 to 15 grains), or by combining with the urotropin acid sodium phosphate in 10-grain doses.

In the acute stage of cystitis all forms of local treatment of the bladder are strongly contraindicated. When, however, the more severe symptoms have passed, bladder lavage is of much assistance.

The treatment of *chronic cystitis* is extremely varied, and depends on the character and duration of the disease. The treatment is one that requires experience and judgment, for if not intelligently carried out the disease may drag on indefinitely, becoming progressively worse.

The first step is to rule out the possibility of infection from disease higher up in the urinary tract. This can only be done by expert cystoscopy, catheterization of ureters, and *x*-ray photographs of the kidney, pelvis, and ureters. It will, of course, be found that in a large percentage of cases the origin of the trouble is from above, and that the essential treatment must be aimed in that direction.

If the diagnosis of chronic cystitis is established the treatment is carried out according to the indications discovered by the cystoscope. For cases of general diffuse inflammation not tubercular, bladder douches are indicated, together with the medication mentioned above.

The solutions most commonly used for bladder lavage are 2 per cent. boric acid, silver nitrate (1 : 10,000 to 5000), and a pale-pink solution of permanganate of potash. Of these, the boric acid is the least irritating and the safest to use, though not as effective as silver nitrate. In giving lavage of the bladder care must be taken not to distend the bladder too much at first, for this not only causes pain, but may open up new avenues of infection. After washing out the bladder it is best to leave in some of the solution, to be voided by the patient about one-half hour later.

Another method of treating the bladder is by instillations, which consists of injecting small amounts of some solution into the bladder and leaving it there for a certain period of time. The solutions most commonly used for this purpose are silver nitrate (1 : 1000), protargol (5 per cent.), and argyrol (30 per cent.).

Kelly recommends gradual distention of the bladder for certain cases when the capacity has become very limited. The treatment is carried out by a series of irrigations by which the amount of fluid injected into the bladder is progressively increased until the bladder, at first capable of holding only 30 or 50 c.c., is made to contain 200 or 300 or even 500 c.c. of fluid. The treatment requires great care and patience. A chart is kept to show the daily increase of bladder capacity (see Kelly and Burnam, Vol. II, p. 464).

The treatment of localized areas of inflammation or ulceration is best carried out by the local application of silver nitrate through an open-air cystoscope, with the patient in the knee-chest position.

Curetage for small ulcerated conditions can be carried out through a large cystoscope, care being taken not to injure the ureteral orifices, or it may be done through a suprapubic opening into the bladder.

In severe long-standing cases of chronic cystitis it may be necessary to give the bladder a complete rest. This may be done either by constant drainage or by creating an artificial fistula. Constant drainage is carried out in the ordinary

way, it being advisable to use a glass catheter, preferably that recommended by Skene. The relief produced by permanent drainage is in some cases remarkable. The bladder should be irrigated once or twice each day. Still more marked is the result of an artificial vesicovaginal fistula. This is done by making an incision through the vesicovaginal septum posterior to the internal urethral orifice. The drainage can be maintained in two ways—either an opening is made large enough for the introduction of a self-retaining glass catheter which is sewed in place, or, preferably, an incision about $\frac{3}{4}$ inch long is made and the mucous membrane of the bladder and vagina sewed to prevent too rapid closure (see page 865). By the latter method the urine drains out continually, as in a case of traumatic fistula. It is best to keep these patients in a hospital until the disease has subsided in its severity, when they may be allowed to go home and be more or less active. If the perineum is tight it is necessary to enlarge it so that the vaginal introitus is funnel shaped, otherwise the urine is damned back in the vagina and bladder with injurious results. The final results of vaginal drainage are excellent. There need be no fear of making the opening into the bladder on the ground of a possible irremediable fistula, for it will be found that there is usually some trouble in keeping the fistula from closing spontaneously. If it does not close of itself, the operation of closure is practically always successful, for there is not, as in traumatic fistula, a loss of tissue, formation of cicatrices, and difficulty in approximating wound edges without tension.

When cases of ulceration of the bladder have resisted all treatment, a radical excision can be performed through a suprapubic incision.

## TUBERCULOSIS OF THE BLADDER

Tuberculosis of the bladder is practically always secondary to some other primary focus in the body. In women the infection is, with few exceptions, secondary to renal tuberculosis, the disease never passing from the genital to the urinary tract, as it does in men. Renal tuberculosis may exist for years, even in a destructive form, before the bladder becomes chronically affected. On the other hand, the cystitis may assume an early and acute type, causing the most distressing and intractable symptoms, such as have been described above. The pathologic changes in the bladder wall range from disseminated tubercles of the mucous membrane, through various stages of ulceration involving the bladder wall more or less deeply, to rare cases of extensive destruction of the wall and invasion of the paravesical tissues.

The **diagnosis** of a suspected case of tuberculosis of the bladder is directed to a search for the primary disease in the offending kidney, and this can at the present time usually be accomplished successfully by catheterization of the ureters, *x*-ray photographs, and renal functional tests.

The **treatment** of vesical tuberculosis consists in the removal of the diseased

kidney if the other kidney is not affected, information of which can be definitely established by the above-named methods of examination.

If the disease in the bladder is not too severe, extirpation of the kidney suffices for a complete cure. Without removal of the kidney a cure is practically out of the question. If, after nephrectomy, the disease still persists, the various methods described above for treating chronic cystitis are available, especially that of drainage through a vesicovaginal opening. If only a localized residuum remains, it can be exsected through a suprapubic incision. In the most extreme cases the bladder has been completely extirpated and the ureters implanted in the bowel. Kelly recommends the simpler method of cutting off the ureters and implanting them in bowel or skin, preferably the latter.

When the disease is far advanced and relief from surgical measures is out of the question, the patient is to be treated like an inoperable cancer case, with doses of morphin sufficiently large to prevent suffering.

### SYPHILIS OF THE BLADDER

Syphilis of the bladder is a very rare affection, having been recognized definitely only a comparatively few times. The manifestations are of the tertiary type, and appear as papillomatous elevations or as ulcerations without distinctive characteristics. The diagnosis is made by a positive Wassermann test, the improvement of the condition under salvarsan, or by finding the Spirochæta pallida in a piece of the gummatous growth excised for microscopic examination.

### CYSTITIS VETULARUM (OLD WOMEN)

Inflammation of the bladder is common in old women, and is a result of general local atrophy which causes so many other disturbances. The shrinking of the tissues about the vaginal introitus affects the meatus, which is gradually drawn inward toward the vagina, often resulting, as we have seen elsewhere, in a partial prolapse of the urethral mucous membrane. The protecting labia minora shrink up and disappear, and the vaginal orifice, losing its former elasticity, remains stiffly open. Thus, the urethra is by its position exposed to infections from a senile vaginitis or from fecal contamination. The cystitis that ensues is a result of direct transmission of pathogenic bacteria through the urethra to the bladder mucous membrane. The resistance of the bladder to infection is greatly lessened in old women as a consequence of the atrophied anemic condition of the mucosa and the diminished elasticity and capacity of the bladder wall. These aged patients suffer greatly from the frequent necessity of urination, often from actual incontinence, by which their rest is incessantly disturbed. Patients of the better class are much distressed by the constant odor of decomposing urine that pervades the room in which they live. Many of these patients are sufferers from other affections, such as rheumatism or

bronchial catarrh, and dread all local manipulation, so that treatment is very difficult. Hot bladder douches give the most relief if they can be given. Occasionally the incontinence can be relieved by the skilful application of a pessary.

Bladder irritation usually occurs in old women, in the absence of bacterial infection, as a result of the senile changes in the bladder wall, which reduce its capacity and contractility. The symptoms are increased micturition and cloudy urine, the appearance in the urine being due to desquamation of the lining epithelium. These patients are often remarkably relieved by an occasional bladder douche given in amount sufficient to distend moderately the contracting bladder wall.

## PYELITIS

Pyelitis relates to a bacterial infection of the mucous membrane of the pelvis of the kidney. It represents a milder form or preliminary stage of the more extensive inflammations of the kidney that pass under the names of pyelonephritis, suppurating kidney, and kidney abscess. The distinction between pyelitis and the more severe forms of kidney inflammation is, therefore, one of clinical convenience rather than of any essential pathologic difference.

Pyelitis bears an important relationship to gynecology in many ways, chief of which are the comparative frequency of the disease as a complication in the convalescence from gynecologic operations, and in the course of pregnancy or the puerperium; its connection with gonorrhea; and the rôle that it plays in certain phases of gynecologic diagnosis. The knowledge of pyelitis has been greatly increased by the use of the cystoscope, and it has been found that the disease is much more common than was formerly supposed, many cases that were before thought to be cystitis now being shown, by more exact methods of diagnosis, to be, in reality, inflammations of the pelvis of the kidney.

The mode of entry of bacteria to the kidney has been a subject of much discussion and experimental work, and it is now known that infection may take place either through the agency of the blood circulation, the hematogenous route, or from the bladder upward through the ureteral canals—the urogenous route.

It has been claimed (Baurereisen, Eisendrath) that infection may reach the kidney by a retrograde route through the lymphatics along the wall of the ureter. Cabot and Crabtree argue against this mode of infection on the ground that the course of the lymphatics to a given region follow in general the course of the blood-vessels to that region. While the exact course of the ureteral lymphatics has as yet not been demonstrated it is known that the blood supply of the ureter is segmental, that is to say, its vessels traverse its wall for a certain distance, then leave it (Danforth). The path of the ureteral lymphatics would, therefore, theoretically be discontinuous. von Franque has demonstrated a lymphatic connection between the ascending colon and the ureter.

Infection by the hematogenous or descending route is by far the more common, as has been proved both by clinical and experimental evidence. In-

fection by the ascending route is evidenced by clinical observations, but has not yet been established by scientific experimentation, although it has been shown that the ureter possesses, like the intestine, the possibility of a retrograde peristalsis.

The pathogenic bacteria responsible for pyelitis are pre-eminently the Coli communis, and of secondary frequency the staphylococcus, streptococcus, proteus, and probably the gonococcus. In addition to these, numerous other special organisms have been described that are either very rare or are possibly modified forms of the more common bacteria. In acute cases the staphylococcus, streptococcus, and proteus are more frequently present, while in chronic cases it is usual to find the colon bacillus in pure culture (Kelly).

The presence of bacteria in the blood and their excretion in the urine does not necessarily betoken an infection of the kidney or its pelvis, for pathogenic organisms may pass through the kidneys for long periods of time without doing local damage. Infection is consequent on some condition that lowers the resistance of the organ, such as might result from a systemic disease or some local interference with the excretory function. Contributory to pyelitis and the other kidney infections are pyemia, septicemia, ulcerative endocarditis, pneumonia, and the acute infectious diseases. Local causes are stone and hydronephrosis resulting from external pressure on the ureters, such as is exerted by tumors. Pregnancy and postoperative sepsis are especially important factors in causation. Ascending infections of the kidney pelvis are apt to follow conditions of urinary retention in the bladder, or inflammatory bladder lesions that affect the tissue at the openings of the ureters.

The etiology of the pyelitis that complicates pregnancy and the puerperium has not been definitely determined. It is supposed that the resistance of the kidney is lowered by retention from pressure of the gravid uterus on the ureters or bladder, and that the infection, which nearly always is the colon bacillus, takes place through the blood route from the intestines, which are apt to be in a condition of stasis favorable for the absorption of bacteria.

Pyelitis complicating gynecologic operations can be explained in no other way than by a hematogenous infection from a septic focus at the seat of the operation. The primary focus is not always apparent, for it not infrequently happens that pyelitis follows operations the wounds of which heal without appreciable sepsis.

It is a matter of observation that surgical operations may light up an old pyelitis contracted during pregnancy. Investigators are divided as to whether the gonococcus ever causes pyelitis. An ascending infection seems improbable. If the cases of so-called gonorrheal pyelitis are authentic, it seems more likely that the gonococci reached the kidney by the hematogenous route, the localization of the disease in the kidney being analogous to gonorrheal infections of the joints.

**Symptoms.**—Acute pyelitis is ushered in with chills and high fever. The

urine contains pus and albumin. The acute attack may end in death, or the fever may recede and become remittent, or the disease may develop into the chronic type. Repetition of chills and exacerbations of temperature signify usually involvement of the kidney parenchyma with abscess formation. Pain and tenderness of the kidney is usually, but not always, present.

Chronic pyelitis may be the end-result of an acute attack, but more commonly starts as the chronic form from the beginning.

The symptomatology of pyelitis is not always clearly defined. The essential symptoms are pus in the urine, sensitiveness of the kidney region, moderate swelling of the involved kidney, leukocytosis, irritability of the bladder, and disturbances of the general health. None of these symptoms are, however, to be relied upon. A pyelitis may exist many years without alteration in the health, constitutional changes being due rather to the gradual involvement of the kidney, which evokes the symptoms characteristic of diffuse hematogenous nephritis.

Sensitiveness of the kidney, as shown by pain or tenderness, is present in only about half of the cases, while an appreciable enlargement of the kidney, such as can be felt by manual examination, appears in only about one-quarter of the cases. Dilatation of the pelvis, when present, is due to some obstruction or dislocation of the ureter, which may in some cases produce an intermittent enlargement of the pelvis like that seen in hydronephrosis.

Cystitis is not always present, as the infected urine may pass through the bladder for a long time without exciting inflammation. Frequency of urination is, however, practically always present, due partly to chemical irritation of the bladder and partly to the fact that in most cases of chronic pyelitis there is an excretion of large quantities of urine (Kelly).

As far as the examination of the urine goes, the presence of pus is the only constant sign. The reaction is usually acid, but may be alkaline. The caudate epithelial cells, formerly regarded as of important diagnostic value, are now known to be simulated by cells from the deeper layers of the epithelium lining the lower urinary tract. In a case of simple pyelitis the amount of albumin in the urine corresponds only to the pus contents. If the albumin is increased it bespeaks an involvement of the parenchyma of the kidney—pyelonephritis. Renal casts are not found in simple pyelitis, and their appearance signifies a pyelonephritis, though their absence does not necessarily rule out a nephritis extension.

Leukocytosis is usually present, but there are exceptions to the rule. As pus in the urine is the only constant sign, the final diagnosis of pyelitis must be made with the cystoscope. In a pronounced case the diagnosis can be made by observing cloudy urine spurting from the urethral orifice. The ureters are then catheterized, and the diagnosis made by examination of the two specimens of urine. In a case of simple pyelitis the functional test of the kidneys shows little or no difference between the two sides. If, however, the kidney itself is implicated, the diseased side will always show retarded function.

**Postoperative Pyelitis.**—The clinical course of the postoperative pyelitis which frequently occurs as a complication during the convalescence from gynecologic operations is so characteristic that it deserves special mention. It appears more frequently after abdominal operations than after simple plastic or external operations, although it may occur after the latter. It is rather more common in women who have borne children. This is due to the fact that pyelitis is a frequent complication in pregnancy and, as has been stated, a patient who has once passed through an attack is extremely liable to a later recurrence either from another childbirth or from a surgical operation, even though it be years after the initial attack. A close examination of the histories of all patients who develop a postoperative pyelitis, whether they have borne children or not, will reveal a surprisingly large percentage of previous attacks.[1]

The time of onset of pyelitis following surgical operation seems to characterize two types of the disease. In one the initial symptoms appear within two or three days following the operation. In the other the symptoms are not evident for one or two or even three weeks after operation. It has been a matter of personal observation that when the disease appears late the symptoms are more severe and last somewhat longer than when it develops early.

As a rule, postoperative pyelitis comes unexpectedly in a patient who is making an otherwise satisfactory convalescence. The onset may be mild or severe. In the mild form the first evidence is a burning on micturition with a moderate rise of temperature and a general sense of malaise. The urine shows an increase of leukocytes. The symptoms increase for a few days and then subside. Even in the mild form the temperature may rise to 103° F. If the attack is early the time of surgical convalescence may not be prolonged and the patient may be little inconvenienced. Such a patient, however, is more susceptible to another attack if she undergoes a surgical operation at some later date. There is also possibility of recurrence during the convalescence.

In the severer forms the attack may be acute and often alarming. There may be sudden intense pain on micturition. The temperature runs a characteristically high course for one or two days, frequently reaching 104° and 105° F. In these cases the kidneys usually show evident signs of the disease. One or both kidneys may be palpably enlarged, tender, and painful. Often these signs appear first in one kidney and then in the other as the first subsides. The average course in the severe form is about a week, though pus in the urine persists considerably longer. Patients are subject to one or more recurrences with intervals of a few days to several weeks.

The great majority of postoperative pyelitis cases get well without leaving serious injury except a greater susceptibility to the disease.

The **prognosis** of pyelitis is variable. A simple pyelitis may last years with-

[1] Danforth has called attention to the frequency of pyelitis in infancy, and thinks that untreated infections of the kidney in infancy may be the starting-point for urinary lesions of a more serious character in later life. He also emphasizes the fact that many pass through pregnancy with an infected kidney of mild degree which fails of recognition.

out encroaching on the kidney, but it may extend to the renal parenchyma and cause pyelonephritis. A quiescent pyelitis is very apt to be lighted up by pregnancy and labor or by surgical, especially gynecologic, operations.

The prognosis of unilateral affections is better than that of bilateral disease in which uremic conditions may ensue.

The **treatment** of acute pyelitis consists of rest in bed, hot applications, abundant ingestion of water, and urotropin.

The treatment of chronic pyelitis is practically the same. Cases which do not yield to general medical measures can often be cured by lavage of the renal pelvis with solutions of silver nitrate (1 : 1000), bichlorid of mercury (1 : 10,000), and formalin (1 : 3000) (Kelly), the solutions being made somewhat stronger as the treatment progresses. Vaccine therapy has been recommended, but most observers have found it of little value.

Kretschmer has recently emphasized the fact that failure to cure chronic pyelitis is in many cases due to the neglect of treating accessory affections which may themselves be contributing causes of maintaining a pyelitis. Of these the most important are lesions of the gastro-intestinal tract. Chronic constipation or conditions of colitis are a frequent source of infection by the hematogenous route. With these may also be included rectal lesions like fistulæ, hemorrhoids, and fissures. Pelvic tumors, such as uterine fibroids, that press on the ureter, or chronic inflammatory processes that constrict by adhesions the ureteral lumen are occasional causes of an intractable pyelitis.

Of very great importance are the inherent strictures of the ureters described by Hunner (*q. v.*).

Surgical procedures for the relief of pyelitis must be directed toward the removal of such causative conditions as pelvic tumors or constriction of the ureters, stones of the renal pelvis, etc. Surgical operations on the kidney for simple pyelitis are not commonly indicated. Nephrotomy, or splitting the kidney and leaving it open for drainage, is recommended, especially by Casper, but it is not an operation in general favor. Nephrectomy is indicated in those cases where an intractable cystitis is maintained by a pyelitis, and which does not yield to non-surgical treatment.

**Hunner Stricture of the Ureter.**—Of great importance to the gynecologist is a knowledge of the frequency of a special type of ureteral stricture, described by G. L. Hunner. Space does not allow a full description of this lesion and the student of the subject is referred to Hunner's monographs. It may be stated briefly that stricture of the ureter is much more common than is generally recognized. According to Hunner the strictures result from a local inflammation of the ureteral wall, the source of infection being by the hematogenous route from some distant focus like the tonsils, sinuses, teeth or gastro-intestinal tract, possibly also the cervix. The strictures may be single or multiple, unilateral or bilateral. The most common locations are in the broad ligament about 6 cm. from the bladder, and at the bifurcation of the internal

iliac vessels, about 8 to 10 cm. above the bladder. The chief symptom is pain either corresponding to the site of the stricture or in the kidney region. The pain often simulates that of appendicitis or of pelvic disease and may cause serious mistakes in diagnosis. Attacks may be intermittent with chills and fever. Urinary discomfort is often absent and the urine may be entirely negative. The stricture may be the origin of various complications such as pyelitis, hydro- and pyonephrosis, ureteral stone, and those bleedings that were formerly classified as idiopathic hematurias. Diagnosis is made by passing wax-bulb ureteral catheters with the assistance of *x*-ray ureterograms. The treatment is by gradual dilatation with the wax-bulb catheters. It requires great skill and should be attempted only by an expert cystoscopist. Hunner recommends the direct method with Kelly's cystoscope. In some cases the stricture is dilated from above through an incision made at McBurney's point. Very severe strictures may require such radical operations as nephrectomy or ureteral transplantation.

## INFLAMMATION OF THE COLON

### DIVERTICULITIS

An important affection of the large intestine which the pelvic surgeon must bear in mind in the diagnosis of acute abdominal conditions, and which he must be prepared to treat when unexpectedly encountered, is diverticulitis of the colon.

Diverticulitis is a disease the clinical and surgical significance of which has been only quite recently recognized, though anatomic knowledge of acquired intestinal diverticula has existed for many years.

Sömmering, as far back as 1794, described a case of acquired diverticula of the small intestine. In 1845 Gross demonstrated and pictured diverticula in the large intestine. The condition was also described by Klebs, Alibert, Schröder, Sydney Jones, Astley Cooper, and others. In 1896 Hanseman found, at autopsy of a man of eighty-five, four hundred diverticula occurring throughout the entire length of the intestines. These historic cases were all from autopsies and were regarded merely as anatomic curiosities. In the translation of Nothnagel's Encyclopedia, published as recently as 1904, the following statement is made: "As these lesions (acquired diverticula) are chiefly of anatomic interest and have very little clinical significance, only a few general remarks will be made on this question."

The general recognition of the surgical importance of the subject may be said to date back only a few years. In 1906 Sampson and Gogornier published their case of obstruction from diverticulitis of the small intestine, and called attention to the fact that acquired diverticula not only occurred more frequently than is supposed by pathologists, but that they are the unrecognized etiologic factors in many inflammatory processes of the intestine, especially those occurring in the region of the sigmoid. In 1907 W. J. Mayo published 5 cases of diverticulitis of the sigmoid and at that time was able to collect only 18 other authentic cases from the literature. Since then surgeons and pathologists have given closer attention to the subject, and the record of cases is rapidly increasing both in the operating room and in the laboratory.

Acquired diverticula are to be distinguished from so-called congenital diverticula, of which Meckel's diverticulum and the vermiform appendix are

the most familiar examples. It was formerly supposed that the acquired variety results from an actual hernia of the mucous coat through the fibers of the muscles of the intestines, and the term "false diverticula" was applied to them by Cruveilhier and Rokitansky, to distinguish them from the so-called "true diverticula," the name applied to the congenital form in which all the coats of the intestines are present. It has since been learned, however, that in the early stages of an acquired diverticulum all the coats are present, but that, as it develops, the muscle-fibers become atrophied by pressure and disappear partially or completely. The terms "true" and "false" are, therefore, no longer to be used synonomously with "congenital" and "acquired."

Acquired diverticula may appear at any point in the entire length of the intestines, though more commonly in the sigmoidal region. They are rarely if ever seen in the rectum. Their occurrence in the appendix itself has been noted by Kelynak, Ribbert, Edel, Fischer, Mertens, Kelly, and others. The diverticula are practically always multiple, and range in number from two or three up to several hundred. In size they rarely occur larger than a hazel nut, and many of them are microscopic. Frequently they are difficult to find, since externally they may be completely hidden in masses of fat, and when searched for from the inner side of the bowel their openings may be so small as to escape notice. The diverticula are at first semiglobular in shape, but as they become larger and more distended they assume a more elongated form, usually with a constricted neck, a point which is of considerable importance in the matter of later pathologic changes. Most of the diverticula of the large intestine contain feces which are retained on account of the constricted nature of the neck. The diverticula of the small intestine, on the other hand, are, for the most part, empty, due partly to the more fluid nature of the intestinal contents and partly to the fact that the openings are less apt to be constricted. In the small intestine the diverticula are almost invariably along the mesenteric attachment, either between the leaves of the mesentery or just to one side. In the large intestine they may occur anywhere, but more commonly they appear on some part of the free border. They are very apt to protrude into the appendices epiploicæ, and this is their commonest situation in the large intestine. Those which enter the epiploic appendages are characterized more than any others by having constricted openings. The walls of most of the more advanced specimens contain only the mucous membrane and serous coat. Some of the diverticula in the same specimen of gut may contain all the coats in their walls; others may be covered with only the longitudinal layers of muscle-fibers, while others may have only the mucous and serous coats.

The **etiology** of these lesions has never been satisfactorily elucidated. It seems fairly evident, though not incontestably proved, that the fully developed condition is acquired and not congenital, from the fact that it has never been discovered in a child, and that it occurs in the great majority of cases after the age of fifty. Most of the cases appear in individuals who have passed middle age and who have a tendency to obesity. In a considerable percentage of the

cases constipation is an associated symptom. Anatomic study of the diverticula shows that they take place either at the point of entrance into the gut of blood-vessels or, more commonly, at the point of attachment of an appendix epiploica, both being sites of lessened resistance.

The early investigators differed as to whether diverticula were formed by traction from without or by pulsion from within. Certain forms of diverticula are caused obviously by the traction of tumors or adhesions. It is conceivable that the diverticula of the small intestine may be caused by traction. The tremendous tractile force which the mesentery of the small intestine exerts on the gut during great distention is sufficiently familiar to surgeons. The diverticula in the free border in the large gut, on the other hand, can be formed in no other way than by pulsion. Apparently the amount of pulsion necessary to produce diveritula does not need to be extraordinary. Given the predisposing factor of innate local muscular deficiency, the ordinary pulsion that normally exists in the bowel is sufficient to bring about the result. An analogous instance is the gradual development of femoral or inguinal hernias in individuals who have never been subjected to strains, and who, on account of an inborn local tissue deficiency, are subject to the formation of hernias from ordinary intra-abdominal pressure.

A sufficient number of cases has been collected from the operating-room and from the pathologic laboratory to show evidence that probably most people having diverticula suffer no harm from them. Diverticula of the small intestine appear to be almost without danger. In nearly all cases where symptoms have arisen the diverticula have been situated in the large intestine and usually in the region of the sigmoid. The reason for this is that the diverticula of the small intestine, unlike those of the large intestine, do not harbor feces.

The mode of infection of diverticula is similar to that of appendicitis. The diverticulum, at first microscopic, becomes gradually pushed out into a pouch with a constricted opening. This pouch becomes a receptacle for feces which are not evacuated on account of the constriction. The fecal contents, decomposing and hardened, become a nidus for various bacterial flora, and the concretion thus formed, irritating and ulcerating the mucous lining of the diverticulum, spreads infection by the lymphatics to the neighboring wall of the gut and to the peritoneum, or else actually perforates the wall of the diverticulum and causes a local abscess. Such an abscess may develop into a general peritonitis, or it may adhere to some hollow organ, more often the bladder, and discharge into it and cause a fistula; or the abscess mass may absorb spontaneously. Heine has collected 8 cases of enterovesical fistulæ which were proved to result from the adhesion of a suppurating diverticulitis to the bladder. Numerous other cases have been reported since. Undoubtedly many of the cases of gas and feces in the bladder have a similar origin. Hochenegge and Griffin have described cases where carcinomata have developed from diverticula.

The **symptoms** of acute diverticulitis are pain in the left side, with the forma-

tion of an inflammatory mass which can sometimes be felt through the left flank, often in the left pelvis, by vaginal examination.

Diverticulitis is of special interest to the gynecologist on account of the location of the inflammatory process in or near the left pelvis. When the disease occurs low down in the bowel the symptoms and objective findings from bimanual examination may simulate closely a pelvic abscess of tubal or ovarian origin. If the disease is located higher up in the flank it may be confounded with a left-sided appendicitis, or with certain other inflammatory processes of the sigmoid, or with cancer. The diagnosis is important, for diverticulitis is as dangerous as acute appendicitis, and requires prompt surgical interference.

Not infrequently a mass of adherent diverticula suggests to the examining finger malignant disease of the descending colon or rectum, and, in fact, even after the abdomen is opened and the mass is under close inspection a differential diagnosis is difficult to make without the removal and microscopic examination of a specimen of tissue. In making the preliminary diagnosis, a radiogram of the lower bowel will often show the diverticula, if present, with great distinctness.

The **treatment** should always be surgical, and is complicated by the fact that the diverticula are practically always multiple, though the inflammatory process may be confined to only one or two of the pouches. In very severe cases the process may be so extensive that nothing more can be done than to open and drain the abscess, from which a persistent fecal fistula nearly always results. When possible, the best treatment is to resect the bowel and to reunite the canal, either by a lateral or end-to-end anastomosis. Sometimes the diverticula are so grouped that they may all be included in the resected segment of bowel. Frequently, however, diverticula must be left behind, which may possibly become inflamed at some later date and cause a repetition of the acute conditions. The author has had one such case.

## ISCHIORECTAL ABSCESS

Ischiorectal abscess is an acute suppurative process located in the perirectal tissue about the lower end of the rectum and anus. Patients with pulmonary tuberculosis, and those who have had gonorrhea of the external genitals, are prone to this affection, though it often appears in individuals otherwise sound. The course of the disease is characterized by preliminary malaise and discomfort on defecation, followed by a chill, rather high fever, and great local pain and tenderness. A characteristic bulging tumor can be seen situated usually at one side of the anus and occupying the ischiorectal space. The abscess may break spontaneously and gradually subside, or, if not incised and drained, it may spread through the cellular and fat tissue in the ischiorectal fossa, and even extend to the opposite side. Such an abscess, if neglected, may cause the death of the patient by general sepsis. On account of the tendency of these infections to extend upward through the cellular and fat tissues, treatment should consist in early free incision and drainage.

Ischiorectal abscesses are especially apt to result in fistulas.

## FISTULA IN ANO

Anal fistulas may be the outcome of previous ischiorectal or perirectal abscesses. The origin is commonly from an infected hemorrhoid. Neglected abscesses and those that rupture spontaneously are usually followed by a permanent fistula, and even those that receive early surgical treatment are apt to suffer the same fate.

The fistulous opening may assume one of several different forms, according to the position of its outlet.

The fistula is said to be complete when it opens both inward toward the bowel and outward on the skin; it is said to be incomplete where there is only one opening, and this opening may lead either inward or outward, the other end of the fistula being blind. The outer opening is usually within one or two inches of the anus, but it may be further away, sometimes even appearing at or inside the perineal outlet. The inside opening is in most cases just within the anal margin between the upper and lower borders of the sphincter muscle. It may, however, be situated above the upper border of the muscle and communicate directly with the lumen of the bowel. There may be a single internal opening which leads by communicating channels to several outlets on the skin. In the severe forms, especially those due to tuberculosis, the tissue may be greatly undermined with numerous openings lined with gray sluggish granulations, the surrounding skin being of a deep purple, unhealthy appearance. Usually the simple fistulæ show externally only a small red papule situated near the anus and containing a minute opening through which a fine probe can be passed (Fig. 75). The internal opening may be microscopic, and is in most cases situated between the internal and external sphincter.

FIG. 75.—FISTULA IN ANO.
The opening of the fistulous tract usually appears as a small pimple near the anus.

Anal fistulæ are extremely persistent and do not often heal spontaneously. Under ordinary circumstances they do not give much pain, but keep the patient in a state of annoyance on account of the continued slight purulent discharge.

In many cases the external opening closes more or less periodically and causes a recurrence of the ischiorectal abscess.

The treatment of fistula in ano is, as a rule, surgical, though some cases are so extensive as to be practicably inoperable. The use of pastes and wax preparations is not recommended except as a last resort, where surgery has failed.

Surgical procedures are usually represented by one of two methods, one by which the fistulous tract is laid open and allowed to heal by granulation, and the other by which the tract is entirely extirpated by careful dissection. These methods are described on page 874.

Dissection of the fistula is recommended, as it is usually followed by a shorter convalescence, and because it involves less danger to the sphincter muscle. The first method of open incision usually necessitates cutting a portion of the sphincter muscle. If the internal opening lies between the upper and lower border of the sphincter, no harm is ordinarily done by dividing the lower external half, especially if the incision be made in a radial direction. If, however, the internal opening is situated above the internal border of the sphincter, division of the muscle may result in permanent fecal incontinence, and may necessitate a later plastic operation for repair. By the dissection method it is usually necessary to do only slight damage to the fibers of the sphincter muscle, and whatever damage is done in the removal of the fistulous tract can readily be repaired by subcutaneous suture at the time of operation.

A third method is one devised by Elting, who removes the lower end of the bowel containing the fistulous opening in the manner of a Whitehead operation for hemorrhoids (see page 869). If the opening is below the internal sphincter and near the external orifice this method is probably superior to those mentioned. If, however, the opening is situated high, the dissection method is preferable.

## FISSURE IN ANO

Anal fissures originate as small cracks in the surface tissue lining the folds of the anal margins. These cracks are usually made by the passage of hard, constipated fecal matter, which produces the lesion either by scratching the membrane or by overstretching the anus. Fissures made in this way usually heal spontaneously, but occasionally they become the seats of chronic ulcers which persist for months or years. The cause of the persistence of these ulcers is not definitely known, but it is thought that it may be due to the fact that the base of the ulcer becomes involved in the fibers of the sphincter muscle and is thus prevented from proper healing.

The fissure bleeds easily and causes exquisite pain on defecation. For this reason the patient shrinks from having bowel movements and falls into a condition of chronic constipation, which, in turn, serves to aggravate the disease.

Long-continued suffering from anal fissure may result in serious depletion of the patient's general health.

The treatment of fissure is best carried out under full anesthesia, when one of two methods can be used—that of stretching the sphincter or that of excision. By the first method the fissure is forcibly and deeply opened, so that it is practically converted into a fresh wound, while theoretically (and possibly practically) the fibers of the sphincter muscle are rendered temporarily less active, so that the fissure is given an opportunity to heal.

A better and more surgical procedure is to make a clean dissection of the fissure, approximating the wound edges carefully with fine catgut.

It is possible to cure a fissure by patient office treatment. This consists in first cocainizing the fissure and then applying to the ulcer silver nitrate, either in solution or in pencil form. The treatment should be repeated several times each week.

It is not always easy to expose an anal fissure to view. If such difficulty is encountered, the best method of examination is to put the patient in Sims' position. The forefinger inserted in the vagina can then easily evert the anal canal. If applications are to be made to the ulcer it is advantageous to place the patient in the *right* Sims' position, as in this way the left forefinger can be used to evert the anus, leaving the right hand free for making the necessary manipulations.

## INFLAMMATORY STRICTURE OF THE RECTUM

One of the most important inflammatory conditions of the rectum seen in gynecologic clinics is stricture. The lumen of the rectum may be constricted in a number of ways, such as by pressure from large impacted tumors of the pelvis, or from retroperitoneal growths, or from polyps and malignant growths of the rectal tissue itself. Extensive parametrial infections may in rare instances obstruct the bowel. The term *stricture of the rectum* is, however, commonly used to designate a special condition of fibrous, cicatricial stenosis of the lumen, usually occurring within $2\frac{1}{2}$ to 3 inches from the anal outlet. The stricture may be annular in form, occupying only a short segment of the bowel wall, or it may be tubular, and extend for a considerable distance toward the sigmoid.

The **etiology** of the disease is somewhat obscure. It was formerly supposed that the majority of these strictures were the result of tertiary syphilitic changes. Modern diagnostic methods have shown that many of these patients do have syphilis, though not all of them. There is evidence that some of the cases are the result of the annular form of intestinal tuberculosis, such as occurs elsewhere in the intestinal tract. Some observers are of the opinion that gonorrheal proctitis with ulceration and subsequent cicatricial healing is important in the causation. Other writers practically rule out gonorrhea as a

factor in the disease. Vulvovaginal abscesses are said to open an avenue of infection to the perirectal tissue and prepare the way for chronic inflammation. Lynch calls attention to the occurrence of cicatricial stenoses following pelvic operations, especially vaginal hysterectomies and end-to-end anastomoses of the rectum, and assigns the result to interference with the circulation of the rectal wall. It is probable that severe rectal ulceration and infection of the perirectal tissue from almost any cause, occurring in the lower part of the rectum, is capable of producing a stricture. In our own series of cases syphilis seems to have been the leading cause, though only in a few cases has it been possible to make a definite diagnosis.

Rectal stricture develops very slowly, patients becoming aware of trouble by gradually increasing difficulty in evacuating the bowel. Frequent painful defecations evoke small masses of thin ribbon-like stools without giving the patient the sensation of having emptied the rectum. Mucus and not infrequently blood are passed. On rectal examination the stricture is usually found within easy reach of the finger. As patients do not seek advice until symptoms of occlusion ensue, the opening of the stricture is always found very small, scarcely admitting the tip of the finger. The rectal wall is densely fibrous and there is to be felt a firm infiltration in the pararectal tissue. The cicatrix about the opening is slightly elastic, and in the annular type can sometimes be stretched sufficiently to allow the finger to slip through. In passing the finger through, one receives the impression that the tissue would easily rupture on forcible pressure. This is entirely true, for even a gentle attempt at dilatation is occasionally followed by a smart hemorrhage. The tubular type of stricture is firmer and less dilatable than the annular.

Some of the strictures occur higher up in the rectum or in the lower sigmoid region, but they are much less common than those that form near the anus. Many strictures, especially those of the syphilitic type, exhibit about the anus numerous irregular tabs of skin, with fissures and rents, commonly called rhagades. They are not pathognomonic of stricture, though they probably are, for the most part, significant of syphilis. The diagnosis of inflammatory stricture is usually a simple matter, but it may be very difficult to distinguish it from cancer or sarcoma. Stricture, as a rule, is attended with little loss of weight or impairment of health, and the symptoms are usually of long duration, in contradistinction to malignant disease, in which there is a comparatively short history of local trouble, together with noticeable cachexia and wasting. The presence of blood and pus in the stools is characteristic of both diseases. In stricture the occluding mass is smoother, more fibrous, slightly elastic, and rather evenly distributed around the rectum. In malignant disease, especially cancer, the mass is irregular and nodular, and apt to be more localized on one side, though this is not always the case. In doubtful cases a Wassermann test should be made. If it is positive, the balance of evidence is in favor of stricture, yet this is not entirely reliable, as was seen in one of our cases, in which a

positive Wassermann was found in a patient who was discovered at autopsy to have rectal cancer.

Sometimes a positive diagnosis can be made readily by removing a piece of tissue for microscopic examination when there is exuberant tissue in the rectal canal. Often, however, tissue of diagnostic value is not easily accessible, and in order to secure a proper specimen it is necessary to cut through the mucous membrane deep into the offending mass. Such a procedure is not always advisable, but, if cancer is suspected and the mass is operable, the most radical measures for securing an immediate diagnosis are justifiable. Inflammatory stricture is sometimes confused with intussusception of the sigmoid.

The **treatment** of inflammatory stricture is either mechanical or surgical, for, even if the disease is proved to be syphilitic in origin, specific treatment is of no local value.

The simplest treatment, and one that may be employed in the great majority of cases, is gradual dilatation. In the annular type, situated very low, occasional repeated stretching with the finger gives complete relief. If the cicatrix is very dense or tubular, or situated beyond the reach of the finger, it is necessary to use graduated rectal bougies. These require skilful care, partly on account of the danger of hemorrhage in stretching the tissue, and partly because of the ease with which one of these instruments may be forced through the rectal wall into the peritoneal cavity, from a blind pouch below the stricture. It is best, therefore, to use the instrument through a proctoscope unless the stricture is very low.

Surgical measures for the relief of stricture are various. The simplest and safest method for the narrow constriction is the use of Lynch's thyrotome, by which the constricting tissue is first seared by a special apparatus and then divided. Much more radical and dangerous is the posterior proctotomy, by which the posterior rectal wall, including both sphincters, is boldly divided, packed, and allowed to granulate.

In complete obstruction a colostomy may always be resorted to with perfect safety to the patient. Occasionally it is advisable to perform a radical operation, in which case the surgical procedure is the same as that for cancer of the rectum.

It should be repeated that, in the great majority of instances, gradual dilatation is all that is necessary, and that the dangerous surgical measures are to be adopted only as a last resort.

# New Growths

## TUMORS OF THE VULVA

### FIBROMA AND FIBROMYOMA

True fibromata of the vulva are comparatively rare tumors, occurring almost exclusively in the labia majora. They do not often reach a size greater than that of a hen's egg, but tumors of large dimensions have been reported. They have

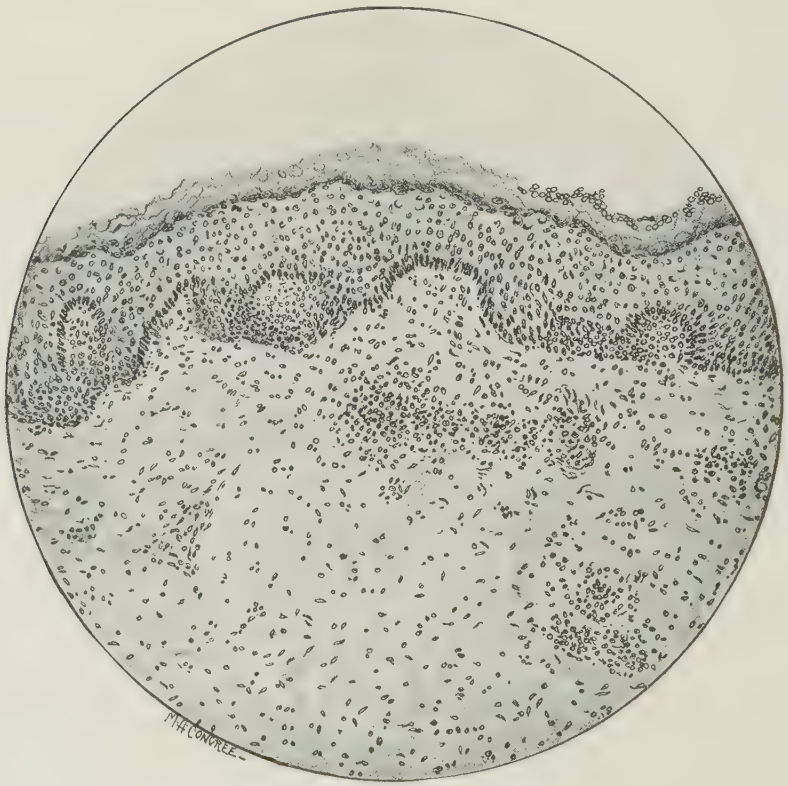

Fig. 76.—Fibroma of the Vulva.

Low power. On the surface is a thin layer of stratified squamous epithelium showing small, poorly developed papillæ. The stroma consists of fibrous tissue infiltrated with small round cells.

their origin in the connective tissue of the greater lips, and are usually hard discrete tumors that can readily be shelled out. Some of them sink down by their weight, drawing the skin out in the form of a pedicle, the consistency of

the tumor becoming softer and more flaccid. This type is termed "fibroma molluscum pendulum."

In some of the tumors can be found smooth muscle-fibers, while in others are seen small glandular or cystic openings that have the appearance of adenomyomatous tissue. A slender stalk is sometimes found connecting the tumor with the inguinal canal. This connection, taken with the histologic appearance of the tumors, suggests that the myomatous and adenomyomatous tumors are probably derived from the round ligament, the tumors of which they closely resemble.

The **symptoms** of fibromata of the vulva depend on the size and position of the tumor, and consist chiefly of discomfort on walking, interference with coitus, and a sense of dragging and weight if the growth is large or pendulous. They are apt to undergo marked swelling, with increase of symptoms before and during menstruation.

The **diagnosis** is usually simple, though there may be some confusion in differentiating the condition from labial hernia, lipoma, or cyst of Bartholin's gland. The fibromata may undergo sarcomatous change.

The **treatment** of fibromata of the vulva is surgical removal. They are easily shelled out as a rule. The pendulous form of tumor may often be removed by simple amputation of the skin pedicle. Operation is always indicated, even when the tumor is giving no symptoms, on account of the possibility of sarcomatous degeneration.

### LIPOMA

Fatty tumors of the vulva are rare. They appear either in the labia majora or in the mons veneris. They are composed of fat in which is mingled a small amount of fibrous tissue. Occasionally myxomatous tissue is found, in which case the growth should be characterized as a mixed tumor.

It is said that the lipomata increase during pregnancy and diminish during the puerperium. They also swell during menstruation.

The consistency of lipomata of the labium is soft and almost fluctuant, so that it is sometimes with difficulty differentiated from a cyst.

The treatment is surgical removal.

A rare tumor of the vulva is called "adenoma hidradenoides vulvæ"; the tumor is benign and shows a growth of glandular tubes lying close together with slight connective-tissue stroma. The glands are lined with regular cylindric epithelium. The structure shows the histologic characteristics of the sweat-glands; hence the name (Stern).

### CARCINOMA OF VULVA

Cancer of the vulva is comparatively uncommon, and does not usually appear until after middle life. It takes its origin chiefly from the urethral orifice, from the clitoris, and from the sulcus between the greater and lesser lips, rarely from Bartholin's glands. In advanced cases the origin cannot usually be distinguished.

The great majority of cancers of the vulva are of the squamous epithelial type, but growths from Bartholin's glands are adenocarcinomatous, while a rare form of melanotic carcinoma has been described. It is possible for cancer of the uterus to become secondarily implanted on the vulva, in which case the growth has the histologic structure of the primary tumor. As a rule, the growth

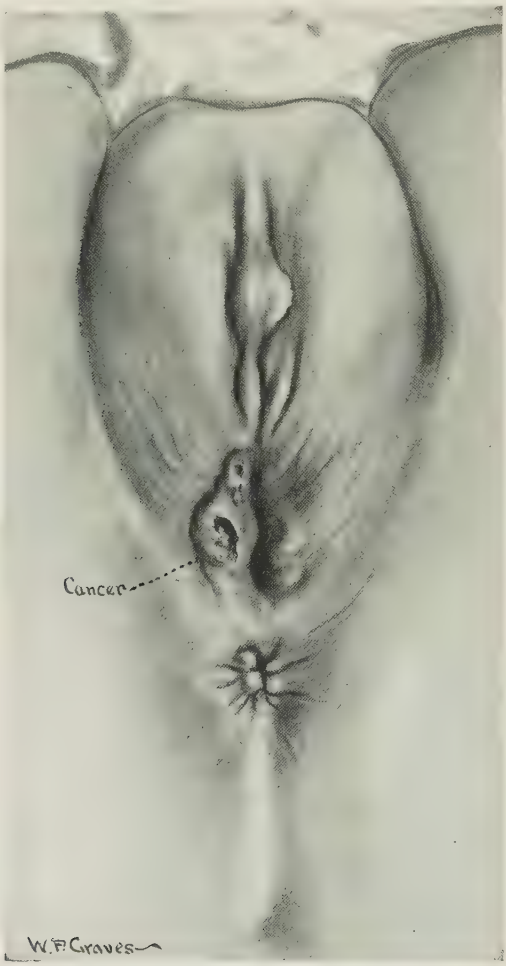


Fig. 77.—Early Cancer of the Vulva, with Infiltration of the Tissues at the Posterior Commissure and Beginning Ulceration.

appears on one side, and is at first irregular and nodular, without ulceration, and is surrounded by a more or less kraurotic tissue, from which it seems to spring.

On account of the rich lymphatic circulation of the vulva, cancer in this location is extremely malignant, and metastasizes early to the inguinal lymph-glands, and thence to the glands of the iliac system.

The disease in the early stages is not painful, and does not at this time often come to the notice of the physician, symptoms ensuing when the tumor becomes

ulcerated or when the inguinal glands become infected. Locally the disease gives rise to itching and burning and a bloody foul secretion bathing the external parts. The involvement of the inguinal glands may be very extensive and exceed in severity the processes of the primary growth. The pain in the later stages of the disease is excruciating, enhanced as it often is by thrombotic extension into the veins of the leg.

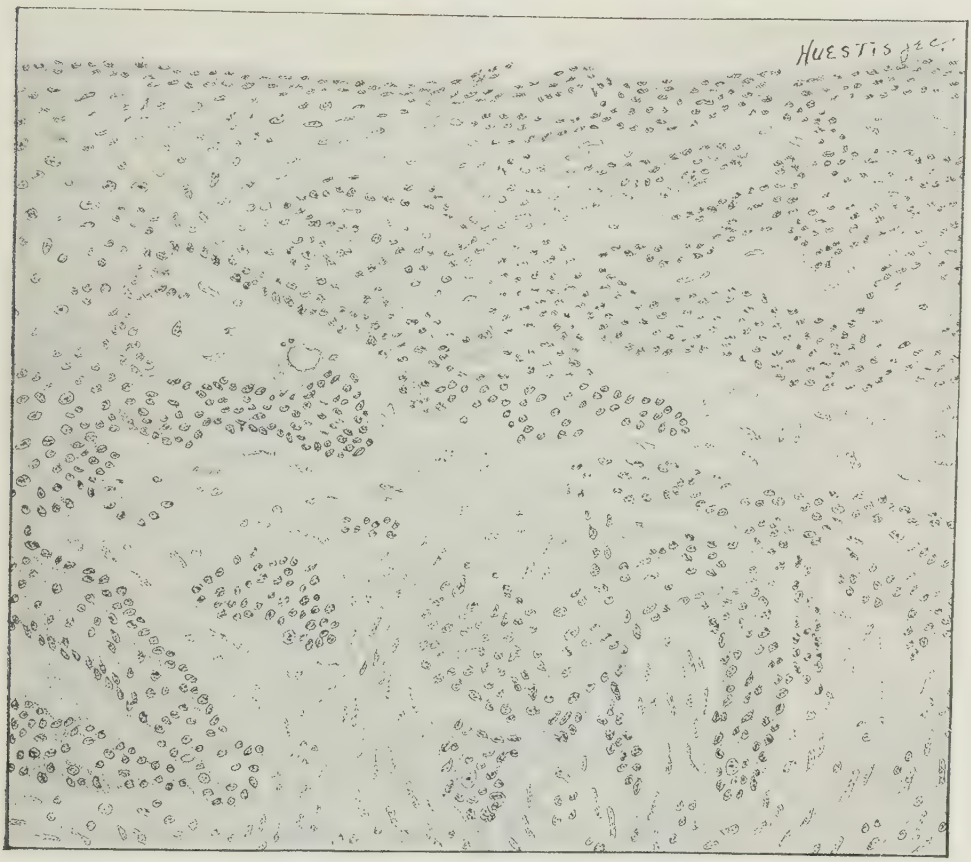

FIG. 78.—EPITHELIOMA OF THE VULVA.

High power. This section shows the surface epithelium, which is not ulcerated, and the finger-like projections of the growth extending into the deeper parts of the stroma of the vulva. There is no basement-membrane between the cells of the growth and those of the stroma. The carcinoma cells are irregular in shape and vary in size. Very few mitotic figures are seen in this section.

The **diagnosis** of cancer of the vulva is not always easy to make by inspection. In the early nodular stage, with beginning ulceration, it may closely resemble a primary syphilitic lesion, while in the later ulcerative stages it may be impossible to distinguish it from esthiomene. The latter diagnosis is especially difficult, for cancer of one side of the vulva is often in time communicated to the other side by contact infection, so that symmetric ulcerations exactly simulating esthiomene are frequently seen. Elephantiasis, tuberculosis, and

even condylomata acuminata are sometimes mistaken for cancer. In all cases where there is the slightest doubt of the diagnosis a specimen should be removed from the growth for microscopic examination.

The **treatment** of cancer of the vulva is immediate and radical operation if the case when seen is operable. The operation consists in an extensive vulvectomy and dissection of the inguinal lymph-glands of both sides. Most of these cases come to operation late, and on account of the tendency to early metastases the prognosis is, consequently, unfavorable as a rule. If the case is inoperable the best hope of relief is from radium.

The most valuable recent work on the subject of cancer of the vulva is that embodied in a report by Taussig of 15 cases personally observed. The following are the conclusions reached by Taussig:

Cancer of the vulva is very definitely a disease of old age, the majority of cases occurring after the age of sixty. The question of age depends, however, on the etiologic factors in the

FIG. 79.—EXTENSIVE CANCER OF THE VULVA ORIGINATING IN CONDYLOMATA ACUMINATA (AFTER TAUSSIG).

case and under certain conditions the disease may appear in young women. Taussig's observations regarding the etiology are especially valuable. Thus in his series of cases he found definite proof that the cancerous growth may originate from the following conditions: trauma, syphilis, condylomata acuminata, kraurosis, leukoplakia, and Paget's disease. The most common predisposing cause is found in the atrophic kraurotic processes that characterize the vulva

in old age. Hence the greater incidence of the disease at that time. On the other hand, it may develop from syphilis or condylomata acuminata, so that it may appear early. Taussig's youngest cases were twenty-seven and thirty-three. The disease is unusually malignant when it occurs in younger women.

Taussig suggests that the cessation of the ovarian secretion after the menopause may be a predisposing element in the development of vulvar cancer, for in two of his comparatively young cases (*i. e.*, under forty-five) a previous operation involving the removal of the ovaries had been performed.

Previous pregnancies are not a factor in the etiology, for the disease appears with about equal frequency in those who have not borne children.

Fig. 80.—Cancer of Clitoris with Metastasis in Groin (after Taussig).

Cancers that originate from a kraurotic vulva are somewhat more benign in their course. They have a tendency to eversion rather than inversion, suggesting that the tissues in the kraurotic cases possess a greater imperviousness to the progress of the disease.

The lymph-glands are involved even in the earliest stages of the disease. "Even after radical removal of the lymph-glands with the vulvar mass the chance for a reappearance of the cancer in the glandular system is three times greater than in the local recurrence."

The site of the original tumor was in order of frequency as follows: labial fold, clitoris, Bartholin's gland, peri-urethral region. When the disease is locally far advanced it may be impossible to distinguish the point of origin. The cancers that developed from the labial folds were more scirrhous in type and slower in growth. Those that sprang from the clitoris or vestibule were of a softer and much more malignant nature.

Taussig has adopted a special technic in operating on cancer of the vulva which will be found explained in detail in Part III of this book. In general his method comprises first a complete dissection of the inguinal regions by the Basset technic. At the end of about two

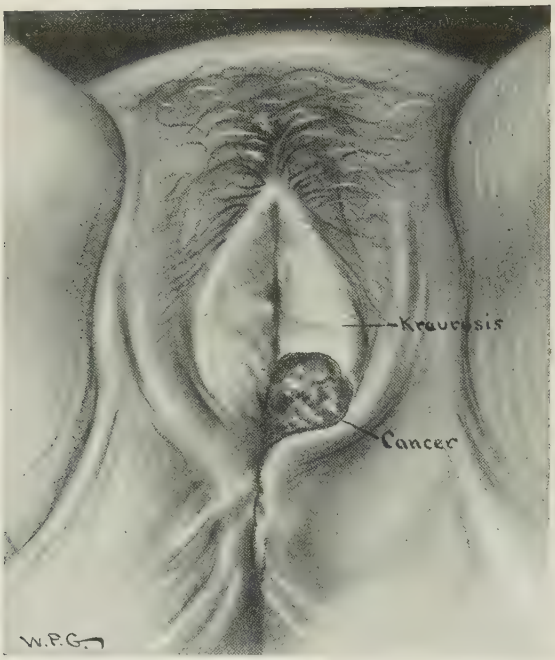


FIG. 81. —CANCER OF VULVA ORIGINATING FROM KRAUROTIC LABIUM.

weeks the tumor mass is removed by cautery, no attempt being made to cover in the wound by plastic maneuvers.

## SARCOMA OF VULVA

Sarcoma of the vulva is even less common than carcinoma. It presents no definite characterizing features clinically, appearing at first as a circumscribed hard oval tumor, not to be distinguished from fibroma excepting by its more rapid growth. Later it may infiltrate the surrounding tissues and, becoming ulcerated, resemble carcinoma or esthiomene. An absolute diagnosis can only be made by the microscope, which reveals various malignant types in different tumors, such as spindle- and round-cell forms, myxosarcoma, and perithelioma. Many of the reported sarcomata of the vulva are melanotic, and doubtless originate in pigmented nevi.

The **treatment** of sarcoma of the vulva is, like that of carcinoma, radical surgery.

**Rare Tumors of the Vulva.**—A few cases have been reported in the literature of neuroma, enchondroma, myxoma, osteoma, teratoma, and echinococcus cyst of the vulva.

**Cysts of Bartholin's gland** have been described on page 192. A few cases of carcinoma developing from this gland have been reported.

**Hydrocele muliebris** is a cyst which sometimes extends from the inguinal canal into one of the labia majora. It represents a cystic condition of the canal of Nuck.

## VARICOCELE

Varicocele of the vulva occurs almost exclusively as a result of pregnancy. The veins may become greatly dilated and form an irregular tumor, usually on one side of the vulva. After delivery the distention either subsides completely or leaves a few isolated veins permanently dilated. These are usually seen in the neighborhood of the clitoris.

Varicocele of the vulva, if extensive, may cause discomforting pain and be a source of danger on account of the possibility of rupture.

Surgical treatment is rarely indicated except when permanent varices of considerable size are left after childbirth. The best treatment is rest in bed, with the use of the knee-chest position two or three times daily.

Rupture may occur spontaneously or after some violent effort, or from trauma. Rupture may result in a large hematoma, or if the skin is broken, in a serious or even fatal hemorrhage.

## URETHRAL CARUNCLE

The urethral caruncle (sometimes termed "papillary angioma") is essentially a mucous polyp of the vestibule. In its most common form it appears as a small polypoid growth, either with a broad base or with a fine slender pedicle growing from the meatus. It is intensely red in color and often exquisitely tender. In exceptional cases the polypoid growth is multiple, extending over a considerable area of the vestibule, so that it has a papillary appearance often suggesting carcinoma.

Microscopically, the true caruncle is clothed with a squamous epithelium. The underlying connective tissue is usually infiltrated with round cells. The epithelial covering sends down off-shoots into the deeper tissues which, on cross-section, present an appearance closely resembling squamous cell carcinoma. Gebhard describes tubular glands that pervade these polyps, the lining epithelium of which exhibits extraordinary changes that range from squamous epithelium, like that of the vestibule, to a high cylindric type with basal membrane.

Clinically, the urethral caruncles may be very troublesome affairs. They are especially apt to occur in elderly women, though not confined to that age. Their importance lies chiefly in the intense pain which they often cause during urination or coitus.

The **diagnosis** is usually simple, though they are sometimes not easily distinguished from a prolapsed urethral mucous membrane except by microscopic examination of the tissue. The true caruncle is covered with squamous epithelium like that of the vestibule, while prolapse of the urethral mucous membrane is covered with the modified epithelium characteristic of the urinary tract.

The extensive caruncular growths that spread out over the vestibule may easily be regarded as cancerous growths. The diagnosis should be made by microscopic examination of an excised specimen. The microscopic resemblance to cancer should be borne in mind.

The **treatment** of simple urethral caruncle is removal under cocain, if possible.

Sometimes, however, the growth is so tender that the patient will not even allow the application of cocain, so that complete anesthesia is necessitated. The caruncle may also be removed by fulguration.

It is advisable not to attempt the removal of the extensive multiple caruncles by surgical dissection, for they usually recur. The best treatment is by repeated applications of the high-frequency current, by which means they are more easily kept under control, though not always permanently cured.

## URETHRA

**Cancer** of the urethra is said to be a rare disease, less than a hundred cases having been reported in the literature. It is, however, probably more frequent

FIG. 82.—PROLAPSED URETHRAL MUCOUS MEMBRANE.

Low power. The crypts in the mucous membrane are seen in cross-section. The epithelium is like that of the urethra. This distinguishes the condition from the true urethral caruncle, which is covered with simple squamous epithelium. The stroma contains many blood-vessels filled with corpuscles and is infiltrated with leukocytes.

than is commonly supposed, since in advanced cases it is difficult to determine whether the disease originated in the urethra or in some neighboring tissue. It usually starts near the urethral orifice, sometimes from a urethral caruncle, as in a case recently reported by Pomeroy and Milward, or from Skene's glands

(Kelly and Burnam). Its direction of extension may be inverting or everting. In the first form it spreads along the paraurethral tissue toward the bladder producing a characteristic hard nodular tube which at first does not invade the vaginal mucosa. In the three cases that have come to our notice this method of growth has been evident. The everting or external form appears at the orifice in a hard, irregular, flattened area which extends over the tissues of the vestibule and clitoris. As the disease progresses it also involves the paraurethra as in the inverting form. According to Kelly and Burnam cancer of the urethra metastasizes in the inguinal canal. Crossen, on the other hand, claims that the invasion is to the intrapelvic glands. In one of our cases the inguinal glands were extensively involved. In another the extension took place in the abdomen, finally causing an intestinal obstruction.

The first symptoms of the disease are usually bleeding and frequency of urination. Pain occurs in the later stages. The treatment of urethral cancer is operative if detected sufficiently early. Crossen recommends a primary drainage of the bladder through the vaginal wall, to be succeeded by a resection of the urethra by an original method which he describes in his Operative Gynecology. The radical operation may be combined with radium.

In advanced cases the only hope of relief is from radium. In our three cases radium caused immediate cessation of pain and bleeding. The relief, however, was only temporary, and in two of the cases a repeated application seemed to aggravate the disease.

**Prolapse** of the urethral mucous membrane is most commonly an affection of old age, though it may appear in infants or in girls before the age of puberty.

Prolapse of the urethra in the adult is usually a result of senile atrophy, and is apparently due to traction of the shrinking skin of the vestibule on the loose mucous membrane of the urethra. In its simplest and most common form it appears as an eversion or ectropion of the urethral mucous membrane, which either in part or in its entire circumference rolls out into view. The affection is often mistaken for caruncle. In the simple form it ordinarily gives no discomfort, but under certain conditions it may be the source of serious trouble. Congestion and constriction of the blood-vessels may produce a change similar to that seen in hemorrhoids, with thrombosis, swelling, and bleeding. In extreme cases there may be gangrene and sloughing of the protruding membrane.

Prolapse of the urethra in which thrombosis has occurred may simulate cancer somewhat in appearance. Treatment of urethral prolapse depends on the severity of the case. Mild conditions which give no symptoms need no special treatment. If congestion, thrombosis, or gangrene appear, the best treatment is surgical removal, the prolapsed and swollen portion of the membrane being removed in the manner of Whitehead's operation for hemorrhoids and the wound edges sewed with fine catgut.

Prolapse of the urethra in children, according to Kelly, may date back to the nursing period of life, and may involve either a part or most of the urethral

mucous membrane. There is pain on urination, reddening and swelling, and often bleeding. Kelly states that the disease either comes on slowly or may develop suddenly from traumatic causes like rape, violent coughing, long-standing diarrhea, local injuries, etc.

The treatment is surgical removal.

## TUMORS OF THE CLITORIS

Tumors of the clitoris are comparatively infrequent. In cases of pseudohermaphroditism the clitoris is often very much enlarged, resembling a small

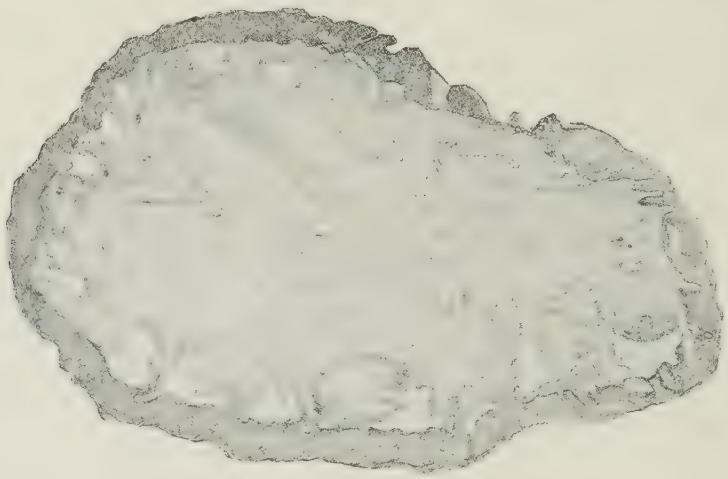

FIG. 83.—HYPERTROPHY OF THE CLITORIS.

Low power. Cross-section of the clitoris. Around the edge is the stratified squamous epithelium. Beneath this and scattered through the stroma are dilated blood- and lymph-spaces. The hypertrophy in the stroma consists of an increase in connective tissue and the corpora cavernosa cannot be made out distinctly.

penis, but not perforated by a urethra. It is sometimes advisable to excise the organ in such cases, expecially if it is a source of irritation. An acquired hypertrophy of the clitoris is occasionally seen, which is thought to be caused by masturbation. There is doubt, however, whether masturbation produces hypertrophy or whether the hypertrophy is not rather the primary condition, causing masturbation by irritative influence. Certain it is that masturbation sometimes results in atrophy of the clitoris (Kustner). Hypertrophy, if it becomes troublesome, requires a clitoridectomy.

Removal of a normal clitoris for masturbation is of questionable value.

Carcinoma of the clitoris is occasionally met with. It follows the course and demands the surgical treatment of any cancer of the vulva, namely, complete vulvectomy and dissection of the inguinal regions.

Carcinoma of the clitoris is sometimes encountered in young women. It is apt to be associated with eczematous lesions in other parts of the body (Fohr).

A rare tumor of the clitoris recently encountered in our practice is a capillary hemor-

Fig. 84.—Squamous Cell Carcinoma of Clitoris.
(Low Power.)

rhagic endothelioma. These growths though not strictly malignant have a tendency to recur, as happened in our case.

## TUMORS OF THE VAGINA

### SARCOMA OF THE VAGINA

Sarcomata of the vagina are comparatively rare tumors. Two forms are to be distinguished: (1) Those which occur in children and (2) those which appear in adult life.

The *sarcomata of children* are usually congenital, and are thought (Wilms) to have their origin in off-shoots of the mesoderm which become detached during the early growth of the Wolffian duct. Histologically, these tumors are primarily composed of myxomatous tissue, connective tissue, and both smooth and striated muscle-fibers, with sarcomatous metaplasia. They are, therefore, not true sarcomata in the strictest sense of the word, but are mixed tumors related to the teratoid group. They usually spring from the anterior wall of the vagina, occasionally from the posterior, and have a characteristic polypoid or grape-like form protruding from the lips of the vulva. The sarcomatous polyps soon become necrotic and the vagina is filled with a septic, sloughing mass. The disease infiltrates the deeper layers of the vagina, soon involves the cervix and bladder, extends to the uterus and vulva, infiltrates the pelvic connective tissue, and metastasizes in the regional lymph-glands. When the growth begins on the posterior wall of the vagina it has little tendency to involve the rectum. The

disease is nearly always fatal, only a very small number of cases having been cured. The only hope of a cure is from a very early diagnosis and a radical extirpation of the uterus and vagina.

*Sarcoma of the vagina in the adult* follows the usual form of sarcoma found in the rest of the body. Cases of melanotic, myxomatous, telangiectatic, and giant-cell type have all been reported. These tumors appear either as nodular or infiltrating growths from any part of the vagina, and involve the entire vaginal canal in a hard, resisting mass. The disease is usually hopeless. If an early diagnosis can be made, the treatment is complete removal of the uterus and vagina.

### CARCINOMA OF VAGINA

Primary cancer of the vagina is somewhat uncommon. These growths usually originate in the squamous epithelium of the vagina, but occasionally are adenocarcinomatous in type, in which case it is supposed that they spring from congenital cysts or gland inclusions of the vaginal mucous membrane.

Cancer of the vagina secondary to cancer of the uterus is frequent, and doubtless many of the cases reported as primary are, in reality, of this kind.

Primary cancer of the vagina usually springs from the posterior wall. On account of this location it has been claimed that the disease is the result of trauma such as would result from the use of pessaries. It is doubtful if pessaries do more than encourage the development of a tissue already predisposed to cancer.

The growth has at first a circular circumscribed appearance with somewhat raised indurated periphery. The original area gradually spreads, infiltrating the paravaginal connective tissue, until it involves the entire vaginal canal. Ulceration and bleeding take place early, and the symptoms are the same as those of cancer of the cervix.

The **diagnosis** of primary cancer of the vagina is usually not difficult unless the disease has so involved the cervix that the original seat of the disease cannot be distinguished.

The **prognosis** of vaginal cancer is very bad, but extirpation is possible if an early diagnosis can be made. The method of operation depends on the original seat of the disease. If it is located high in the vagina the best operation is abdominal extirpation of the uterus and vagina by the Wertheim extended method. If the cancer is situated near the introitus the operation should be from below, and be completed either from below or be combined with abdominal extirpation.

In inoperable cases radium sometimes proves to be valuable as a palliative measure.

When the disease has extended into the rectum the only hope of a cure is a total extirpation of the uterus, vagina, and rectum. This necessitates the establishment of an artificial anus.

Secondary cancer of the vagina is very common, especially as a manifestation of advanced cancer of the cervix. Both everting and inverting carcinoma of the cervix tend in time to involve the paravaginal connective tissue, especially in the anterior wall between the vagina and bladder. It is for this reason that it is important, in performing radical operation for cancer of the cervix, to remove as much of the vagina as possible.

FIG. 85.—SQUAMOUS CARCINOMA OF THE VAGINAL WALL.

Low power. The growth is seen invading the stroma of the vaginal wall. At its upper end it has lost the typical layer of basal cells and the basement-membrane. The cells are large, the nuclei vary greatly in size. The stroma above the growth is infiltrated with leukocytes, an inflammatory reaction often found with carcinoma.

Cancer of the body of the uterus does not directly involve the vagina, but may infect it by metastatic seed implantation.

The vagina may also be the seat of *chorio-epithelioma*. Rarely the tumor is primary in the vagina; it usually represents a metastasis from a primary growth in the uterus.

## VAGINAL CYSTS

Small cysts of the vaginal wall are comparatively common. They vary in size from that of a hazlenut to an English walnut, though rarely they may become

very large, extending upward into the broad ligament. They usually appear on the anterior wall and may be single or multiple. They occur at any age, even in childhood, and first make themselves evident by protruding from the introitus.

The **etiology** of these cysts is somewhat varied. Undoubtedly many of them arise from gland-inclusions formed by infoldings of the mucous membrane in fetal life. This accounts for the smaller cysts. Some of the larger ones probably have their origin in Gärtner's duct. In cases of narrow or unilateral vagina

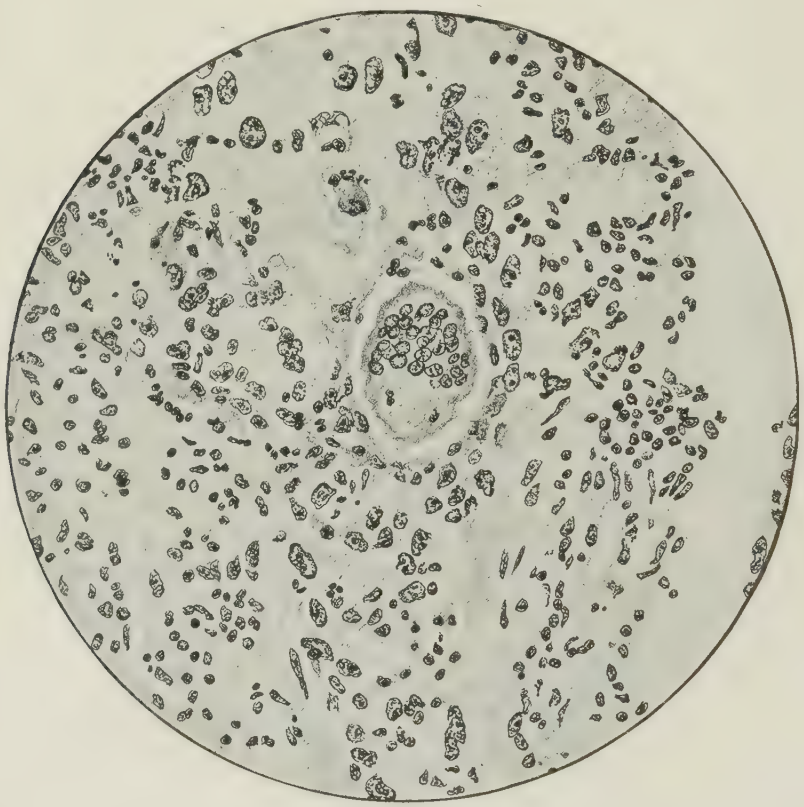

FIG. 86.—SQUAMOUS CARCINOMA OF THE VAGINAL WALL.

High power. Near the center is a giant carcinoma cell containing many nuclei. Just above it to the left is a mitotic figure. This is taken from the small area in the left side of Fig. 79.

it is thought that the cysts may arise from glandular structures representing the undeveloped Müller's duct of the other side. Multiple cysts of the vagina are less common than the single cysts. If they occur in a line they are supposed to originate from Gärtner's duct, while if they are irregularly placed they probably develop from gland inclusions.

The small vaginal cysts do not ordinarily give subjective symptoms, but in married women they often interfere with coitus and sometimes with childbirth.

The diagnosis of vaginal cysts is extremely easy, there being little else with which they could be confused. The cysts have a thin wall lined with a single layer of epithelium and contain a clear serous fluid.

The **treatment** is operative. The smaller cysts can usually be shelled out with comparative ease, though care must be exercised not to injure the bladder. The larger cysts, especially those that extend inward and upward between the leaves of the broad ligament, may present serious technical difficulties. The

FIG. 87.—NORMAL VAGINAL WALL.

Low power. On the surface is a covering of well-developed stratified squamous epithelium. This lies on connective tissue through which are scattered bundles of smooth muscle-fibers and many blood-vessels. .

methods of removal must be determined by the exigencies of the individual case.

Cysts of the anterior wall sometimes communicate with the urethra, in which case they are not true cysts, but are rather divertivula of the urethral canal. It is probable that most cysts of this type originate as periurethral abscesses.

In the lower part of the vagina, near the introitus, cysts may arise from the inclusion of small areas of epithelium following healing from lacerations or operations for repair of the perineum where there has been an incomplete denudation of the mucous membrane. These cysts might properly be included under the

term "perineal cysts," but, as they often result from a high denudation, they may be situated well up in the vaginal canal, usually on one side.

The contents of these cysts is a yellowish, semifluid, sebaceous material, and represents the activity of the included epithelium with retention of the secretion. They are usually about the size of a pea, though they may attain that of a hazelnut. As a rule they are not painful, but sometimes cause a disagreeable irritation at the introitus, which may be so severe as to cause dyspareunia or even

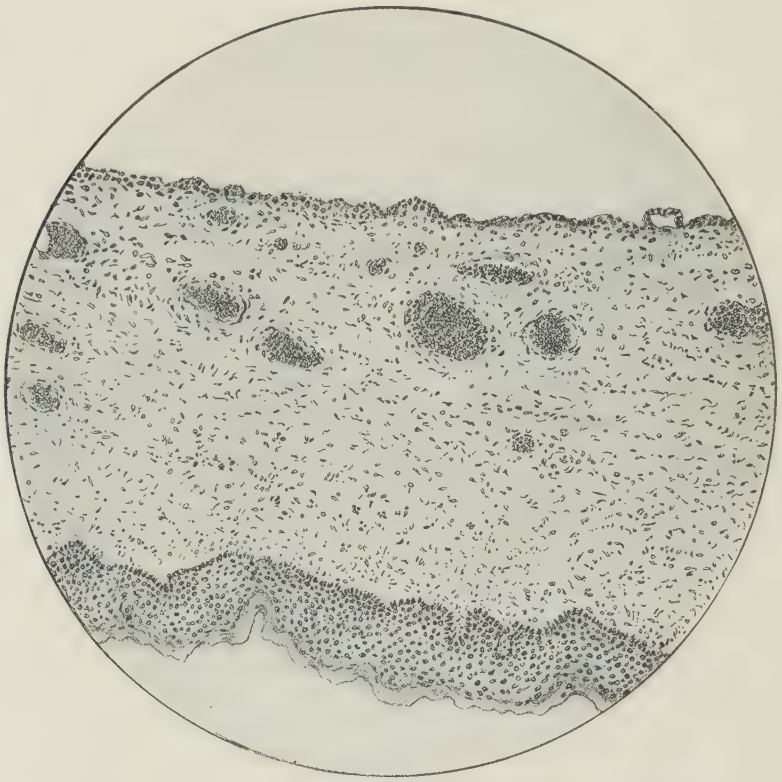

FIG. 88.—WALL OF A VAGINAL CYST.

Low power. At the bottom is the layer of squamous epithelium which lines the vagina. Above this is the connective- and muscle-tissue wall of the vagina and at the top a layer of cuboidal epithelium which lines the cyst. This is characteristic of a cyst of Gärtner's duct.

serious vaginismus. The treatment is removal by dissection if they give symptoms.

A special form of vaginal cyst and one which may cause serious surgical complications is that which results from a blind secondary vagina. There are two types of defective development which may cause vaginal cysts of this kind. In one there exists a rudimentary uterus and a rudimentary blind vagina, the canals of which do not communicate (Fig. 89). In these cases the cervix of the rudimentary uterus becomes fused with that of the well-developed organ. Secre-

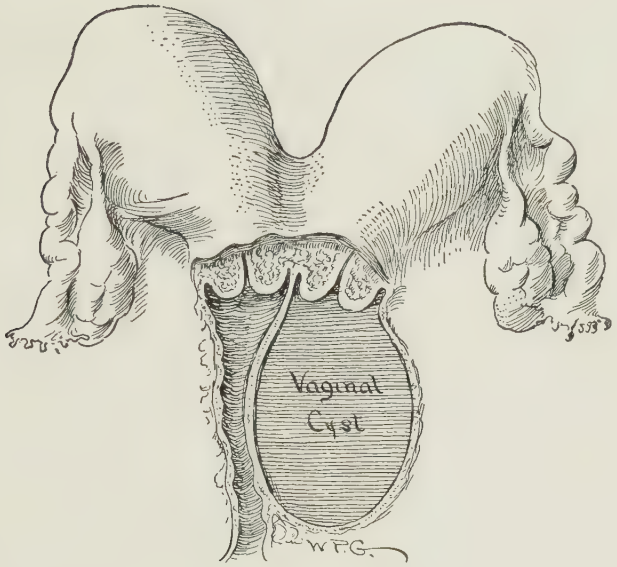


FIG. 89.—VAGINAL CYST DUE TO BLIND SUPERNUMERARY VAGINA.

In this case both horns and cervices are fully developed. There are two vaginas, but one has no outlet. The blind vagina is converted into a cyst which becomes filled with products of menstruation from the corresponding uterine horn.

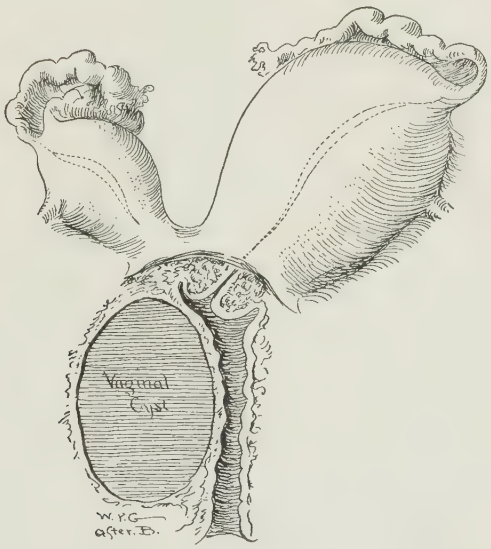


FIG. 90.—VAGINAL CYST DUE TO BLIND SUPERNUMERARY VAGINA.

On one side there is a fully developed uterine horn, cervix, and vagina. On the other is a rudimentary uterine horn, the cervix being fused and without a canal. Corresponding to the rudimentary horn is an undeveloped vagina without an outlet. Secretions have converted the vagina into a cyst.

tions accumulate in the blind vaginal sac and produce a cyst, as shown in the drawing.

In another type there exists a double uterus, double cervix, and double vagina, but the vagina of one side is without an external opening. In this case

the blind vagina becomes filled with menstrual products in the form of a characteristic chocolate colored fluid. Sometimes the pressure may be so great as to break an opening through into the normal vagina. When this occurs the contents of the sac become infected and the blind vagina is converted into a reservoir of foul pus which discharges constantly or periodically into the normal vagina.

In a case seen by the writer one of the horns of a double uterus had been removed several years before by another operator. When the patient presented herself for examination there was found an immense pus sac which was discharging through the cervix of the remaining uterus

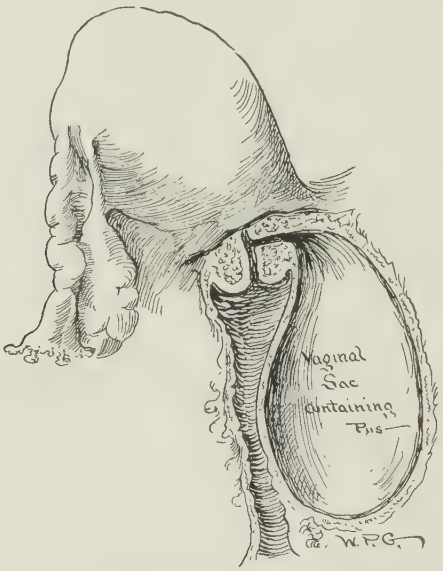


Fig. 91.—Vaginal Cyst Due to Blind Supernumerary Vagina.

Drawing illustrates author's case described in the text. One uterine horn had been amputated by a previous operator. A cyst which had formed in a blind vagina had forced an opening into the cervical canal. The contents of the vaginal sac had become infected so that the sac fed by the uterine secretions became a reservoir of foul pus.

After an unsuccessful attempt to rectify the trouble by draining the abscess through the vagina the patient was finally cured by performing a complete hysterectomy and establishing full drainage for the abscess sac through both vagina and abdominal wall. After a time the vaginal sac dried up, the walls evidently healed together by plastic adhesions, and the patient got well. In this case the septum between the two vaginæ had become the seat of a great plexus of vaginal veins, so that an attempt to remove the septum and to convert the two vaginæ into a single canal could not be carried out. Otherwise this procedure would theoretically have been preferable to the operation of hysterectomy, as the patient was a young woman.

**Fibromyomata** and **myomata** of the vagina are very rare tumors, less than 200 having been reported. They arise from the smooth muscle-tissue of the vaginal wall. They do not attain a large size, and are usually polypoid in their development. They have a predilection for the posterior wall of the vagina. They are

especially prone to necrosis, infection, and sloughing, and occasionally undergo sarcomatous metaplasia. As a rule, they are well defined from the surrounding tissue and can be shelled out like uterine myomata. Sometimes they grow diffusely and cannot be removed except by dissection, in which case they are found to be adenomyomata, probably originating in Gärtner's duct.

The *treatment* of vaginal myomata is operative removal.

**Adenomyomas of the rectovaginal septum** are comparatively rare tumors, though it is probable that they are more common than has generally been supposed, many cases having been overlooked from mistaken diagnosis. These tumors have for some time been recognized and a few cases reported. Cullen has recently called attention to their importance and has described them more accurately than has been done heretofore.

Cullen classifies adenomyomas of the rectovaginal septum as follows:

1. Small adenomyomas lying relatively free in the rectovaginal septum.
2. Adenomyomas adherent to the posterior surface of the cervix and at the same time to the anterior surface of the rectum.
3. Adenomyomas gluing the cervix and rectum together and spreading out into one or both broad ligaments.
4. Adenomyomas involving the posterior surface of the cervix, the rectum and broad ligaments, and forming a dense pelvic mass that cannot be liberated.

In the majority of cases the growth is felt as a diffuse thickening behind the cervix in which the cervix and rectum are involved. Sometimes the mass is nodular, giving the impression of an adherent myoma. If the tumor has grown extensively the whole pelvis floor and vaginal vault may be hard and indurated. In the early stages the tumor may be discrete and movable, usually attached to the posterior wall of the cervix.

By rectal examination the tumors may usually be more definitely outlined. The rectal mucosa is, as a rule, not impaired, but the tumor mass projects in the lumen of the bowel, occasionally constricting it. The rectal mucosa over the tumor mass may become polypoid.

Histologically, adenomyomas of the septum present the same picture as seen in the uterine adenomyomas. The structure consists of unstriped muscle and connective-tissue fibers in which are scattered singly or in groups glandular elements of the type seen in the uterine mucosa. The glands invariably lie in a bed of cellular tissue like the stroma that surrounds the glands of the endometrium. Sometimes the glands become dilated and may form cysts of considerable size. The histogenesis of the adenomyomas is somewhat vague, but on account of their characteristic structure is referred unquestionably either to the uterine mucosa or to rests of the Müllerian duct.

The most pronounced symptom of these tumors is menorrhagia, all the cases reported by Cullen having occurred during the menstruating era and ranging in age from twenty-five to fifty-three. Pain with menstruation is not a constant

symptom, but may be present and is sometimes very severe. As would be expected, rectal pain is often a prominent symptom.

If the lumen of the bowel is obstructed the rectal discomfort may be great, with frequent discharges and tenesmus.

When the disease has spread out into the broad ligaments and throughout the floor of the pelvis general pelvic discomfort is to be expected, with pains shooting into the legs as the result of the involvement of nerves by the encroaching fibrous tissue of the tumor.

The diagnosis of the adenomyomas may be difficult. The condition most likely to be confounded with them is inoperable cancer involving vagina and rectum. It should be remembered that in the adenomyomatous growths the mucosa of the rectum is always intact except for a possible polypoid hypertrophy. Conditions of low-growing uterine or of cervical fibroids combined with chronic pelvic and parametrial inflammation may cause difficulty in exact differential diagnosis. In the latter cases, however, lack of involvement of the rectal wall can usually be demonstrated.

The surgical treatment of adenomyomas of the rectovaginal septum may best be presented by the following quotation from Cullen:

"Some might argue that simple removal of the appendages would cause atrophy of the uterine mucosa contained in the adenomyomas of the rectovaginal septum. My Case 2 is a sufficient answer. Although a supravaginal hysterectomy had been performed two years before for a myomatous uterus, the pelvic condition had grown steadily worse.

"1. Where small discrete nodules exist in the posterior vaginal vault, these may be readily removed through a vaginal incision, as was so successfully done by Stevens.

"2. Where the growth occupies the posterior surface of the cervix and extends laterally, after the ureters have been dissected out carefully, a complete abdominal hysterectomy should be performed.

"3. If the growth be firmly adherent to the rectum, a wedge of the rectum should be removed, together with the uterus. It has been found best, after freeing the uterus on all sides, to open up the vagina anteriorly and laterally. The uterus and the rectum can then be lifted farther out of the pelvis, thus facilitating the removal of the necessary wedge of the anterior rectal wall. The uterus really acts as a handle, and the necessary rectal tissue and the uterus are removed as one piece.

"4. Where the lumen of the bowel is greatly narrowed, a complete segment of the rectum should be removed with the uterus, and an anastomosis should be made.

"5. In desperate cases, where everything in the pelvis is glued together, an ideal operation is out of the question. The patient will not stand a long operation, and, if she could, a satisfactory result could not be obtained. In such a case it would be better to cut across the sigmoid, invert the lower end, close it, and bring the upper end out through the abdominal wall of the left iliac fossa, making a permanent colostomy. When the patient has to some extent regained her strength, the uterus, the lower portion of the rectum, and the broad ligament tissue can be shelled out as one piece.

"These growths, while histologically not malignant, remind one of glue. Unless they are completely removed, further trouble is liable to occur."

Author's Note. (Third edition, 1923.) Since the appearance of Dr. Sampson's article on hemorrhagic ovarian cysts the literature of all pelvic adenomyomata must be rewritten. It seems likely that the rectovaginal adenomyomata described by Cullen are the result of endometrial implants from perforating chocolate cysts (*q. v.*).

# NEW GROWTHS OF THE UTERUS

## MYOMA OF THE UTERUS

Uterine fibroids are discrete fibrous growths that develop in the wall of the uterus. These tumors are properly termed "fibroids," "myomata," "fibromyomata," or "leiomyomata" (Mallory). They are constituted of smooth muscle and connective-tissue fibers, their histologic composition being similar to that of the uterine wall. The relative proportion of muscle and connective tissue varies greatly in different tumors. In general, the connective-tissue element tends to increase at the expense of the muscle tissue as the tumor grows older, a process similar to that which takes place in the uterine wall after the child-bearing period.

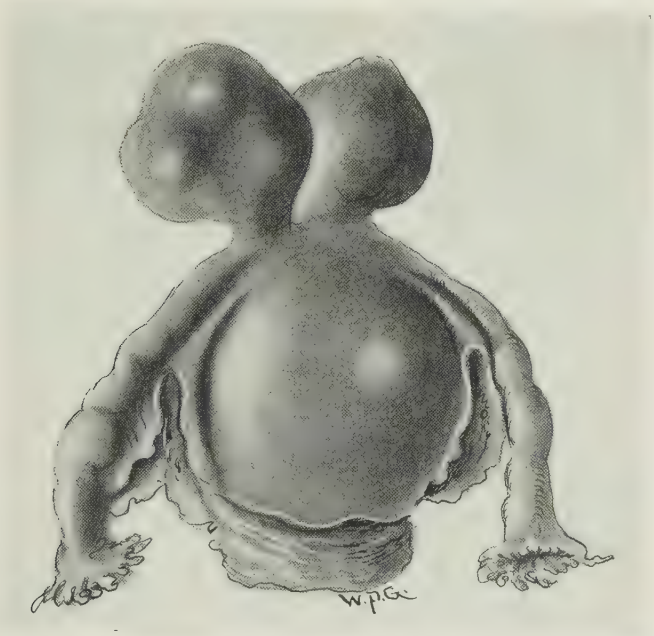

FIG. 92.—SUBSEROUS MYOMATA.

The histogenesis of uterine fibroids is not definitely known. Theories variously ascribe their origin to the muscle cell of the uterus, to the connective-tissue cells of the uterus, to the walls of the blood-vessels, and to misplaced germ cells. The etiology is also vague. Numerous examples have been reported which seem to show that heredity may play some part in their causation. The relative frequency of fibroids in negroes suggests the influence of race as an etiologic factor. The theory of abnormal ovarian hormones as a cause has been presented, but not substantiated. There is no doubt that the function of menstruation is the most important definite factor in the causation of fibroids, for they develop only during the menstrual era. There seems also to be some relationship

between fibroids and the child-bearing function, in that those who have not borne children are undoubtedly somewhat more susceptible to myomatous growth than are those who have been fertile.

Uterine fibroids develop chiefly in the wall of the uterus above the internal os, true cervical fibroids being rare. The particular location of the tumor in the uterine wall is a matter of considerable clinical importance, and fibroids are, therefore, defined by their position of growth. They are divided into three

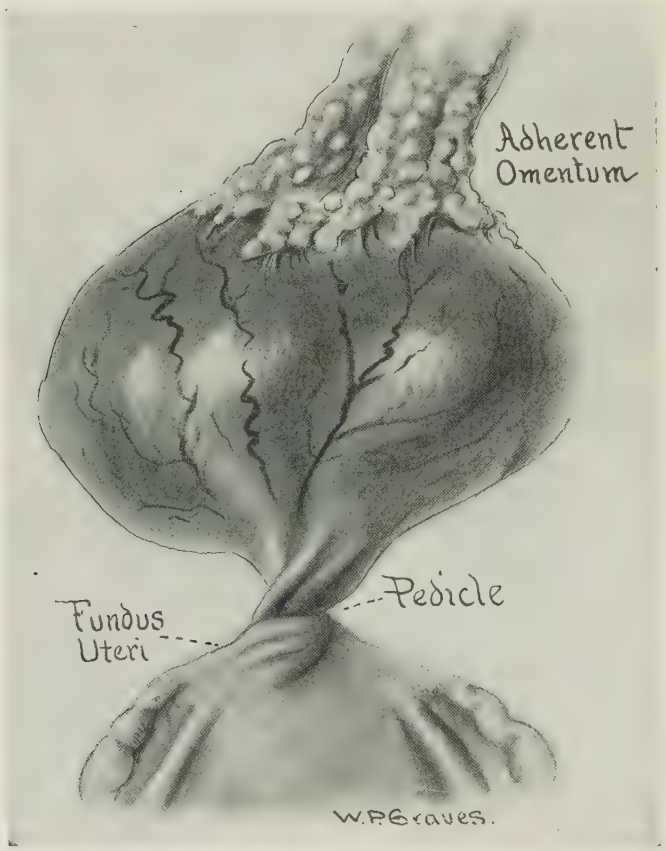


Fig. 93.—Subserous Myoma with Twisted Pedicle.

The omentum is shown adhering to the surface of the tumor. It is in this way that parasitic myomata are formed and nourished by the blood-vessels of the adherent omentum. (Adapted from Kelly and Cullen.)

classes: (1) The subserous; (2) the intramural, and (3) the submucous. They are also to be distinguished by the direction in which they are growing. Thus, a tumor which has a tendency to develop away from the uterine canal is called centrifugal in its growth, while one that develops toward or into the canal is called centripetal. The direction of growth is probably determined by the part of the uterine wall which offers the least resistance. Thus, a myoma beginning near the outer surface would naturally grow toward the peritoneal surface and

become subserous. If it begins near the uterine canal its direction of growth would more likely be toward the endometrium, and thus become submucous. If the origin of the tumor is at the center of the uterine wall, where the resistance of the tissues in both directions is nearly equalized, the tumor is likely to remain as an intramural or interstitial fibroid. Uterine fibroids may appear as one tumor or they may be multiple, representing all three types of development in the same uterus.

Subserous myomata indicate always centrifugal development. This outward tendency of growth may continue until the tumor is joined to the uterine

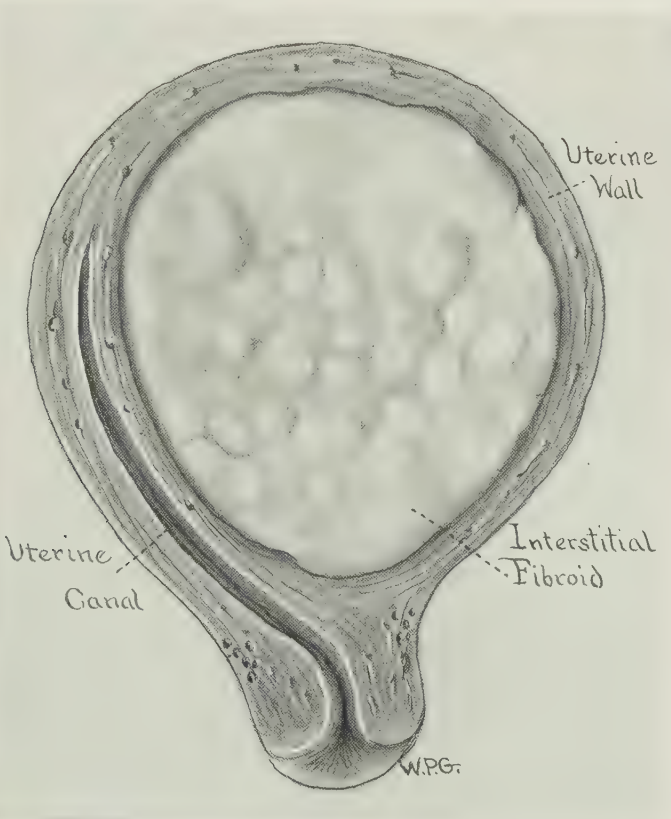


Fig. 94.—Intramural (or Interstitial) Myoma.

wall only by a pedicle through which pass the blood-vessels that give it nourishment. The centrifugal growth may continue to such an extent that the tumor may, as it were, fly off at a tangent and be entirely dissociated from the uterus. This is called a floating or parasitic myoma. The omentum usually attaches itself to such a tumor and gives it feeble sustenance from its blood-vessels.

Interstitial fibroids influence most the uterine wall and may greatly distort the uterus and its canal. These fibroids do not contain a definite capsule, but may easily be shelled out from the surrounding uterine tissue. They are spheric

in form, and are often called "ball myomata," to distinguish them from the adenomyomata which infiltrate the tissues of the uterus irregularly and cannot be shelled out.

Submucous fibroids represent always a centripetal growth. They may encroach on the uterine canal and greatly distort it, or they may become pedunculated and, growing downward in the canal, distend the cervix and present at the external os. They also may spontaneously separate from the uterus and be delivered through the vagina. Submucous fibroids cause a general hypertrophy of the uterus and cervix. The endometrium covering the tumor is thinned out,

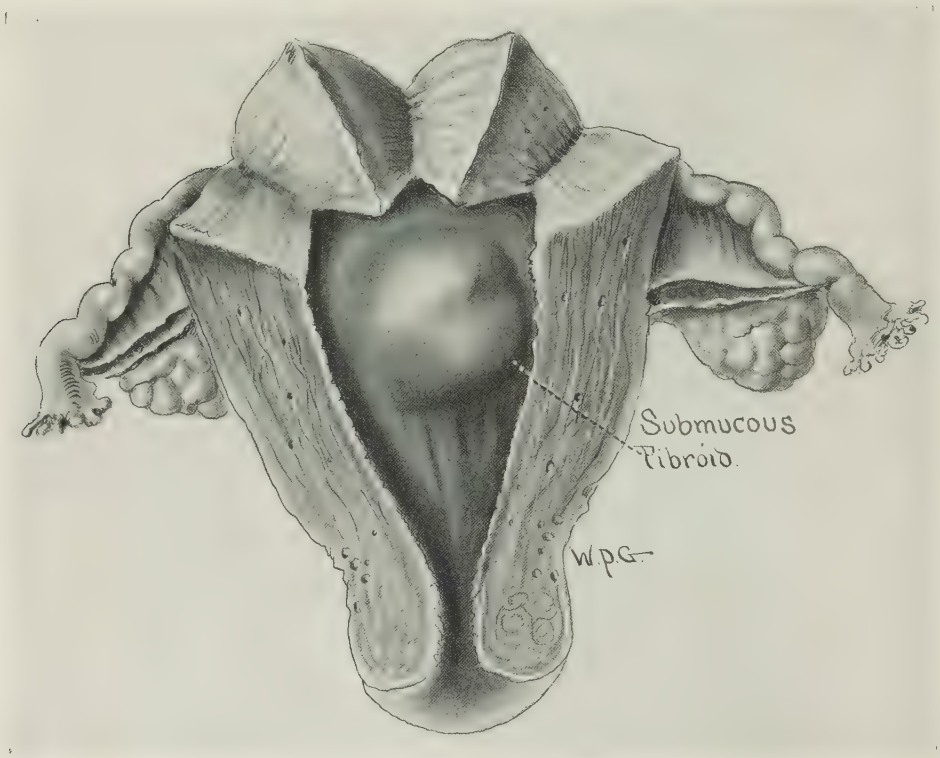


Fig. 95.—Submucous Myoma.

but that of the rest of the canal is hypertrophied and, as we shall see, is the chief source from which abnormal bleeding issues.

Sometimes a centrifugally growing myoma develops from the side of the uterus outward between the leaves of the broad ligament, forming a so-called intraligamentary fibroid or myoma.

Myomata rarely develop originally below the level of the internal os in the cervical tissue, though they do occasionally. Most so-called cervical fibroids originate in the lower uterine segment and, growing downward, encroach on or "take-up" the cervical tissue.

Fig. 96.—Submucous Myoma.
Uterus has been split longitudinally, including the myoma which projects into the uterine canal.

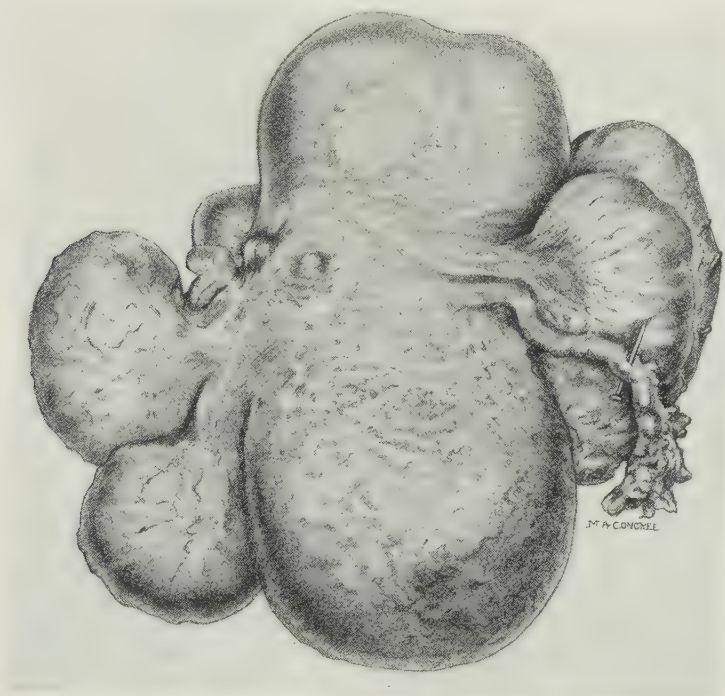

Fig. 97.—Multiple Myomata (Subserous).

True cervical myomata are quite uncommon, but their occurrence is apt to be serious. They do not have the same latitude of growth as do myomata of

the body, so that they cause pressure symptoms comparatively early. They may almost completely fill the lower part of the pelvis, obstructing the bladder and rectum. On account of their location extirpation is difficult and dangerous.

**Degeneration of Myomata.**—Uterine myomata are prone to numerous forms of degeneration, most of which are the result of the inadequate blood-supply that usually characterizes these tumors.

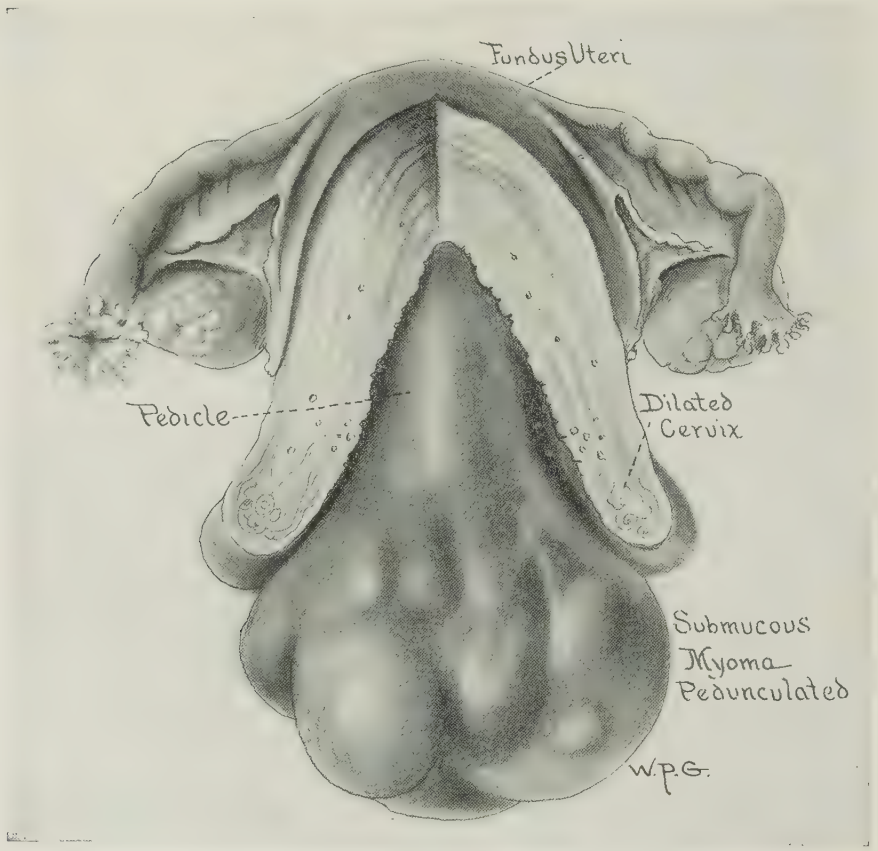


Fig. 98.—Pedunculated Submucous Myoma Extruding from the External Os.

*Hyaline Degeneration.*—This form of degeneration occurs in some part of nearly all fibroids. Its significance is only microscopic and is of no special clinical importance.

*Changes Due to Passive Congestion.*—In this condition the tumor becomes charged to a greater or less extent with the watery constituents of the blood. Three forms are distinguished—edematous, myxomatous, and cystic.

In the edematous form the tumor becomes larger and softer as a result of the serous exudate from obstructed venous circulation. This may result from torsion of a pedunculated fibroid or from torsion of the entire myomatous

uterus, or from any interference with the venous exit of blood from the tumor. The apparent rapid growth of fibroids is often due to enlargement simply from edema.

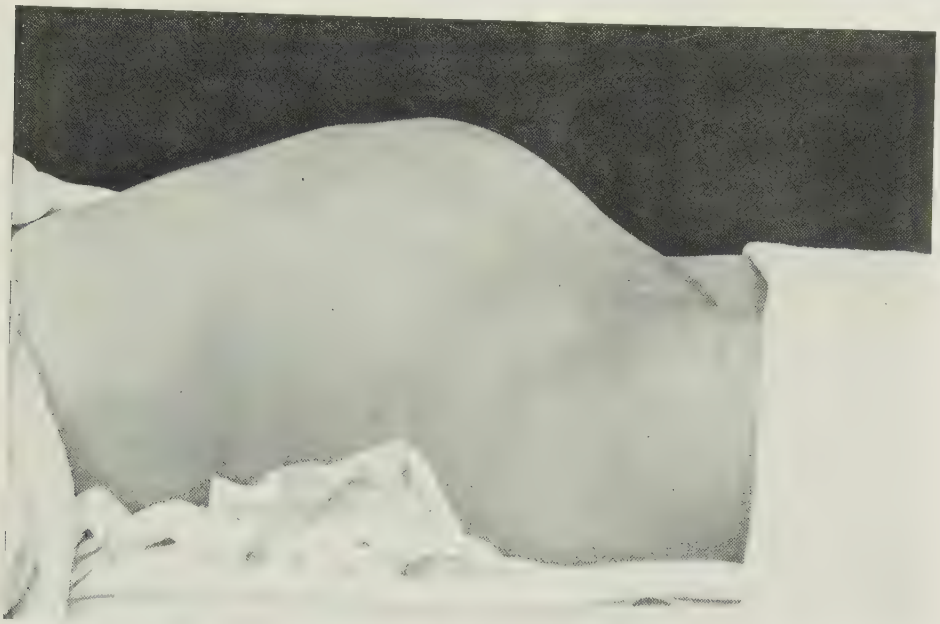

FIG. 99.—CONTOUR OF ABDOMEN WITH LARGE UTERINE FIBROID. (After a photograph.)

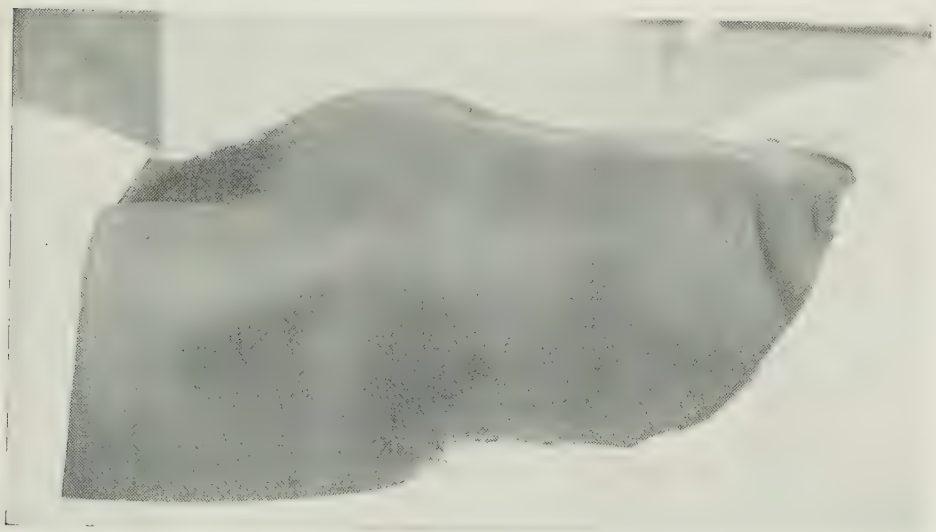

FIG. 100.—CONTOUR OF ABDOMEN WITH UTERINE FIBROID. (After a photograph.)

*Myxomatous degeneration*, so-called, is a misleading term. It is simply an advanced form of edema as a rule. The connective-tissue cells become so widely

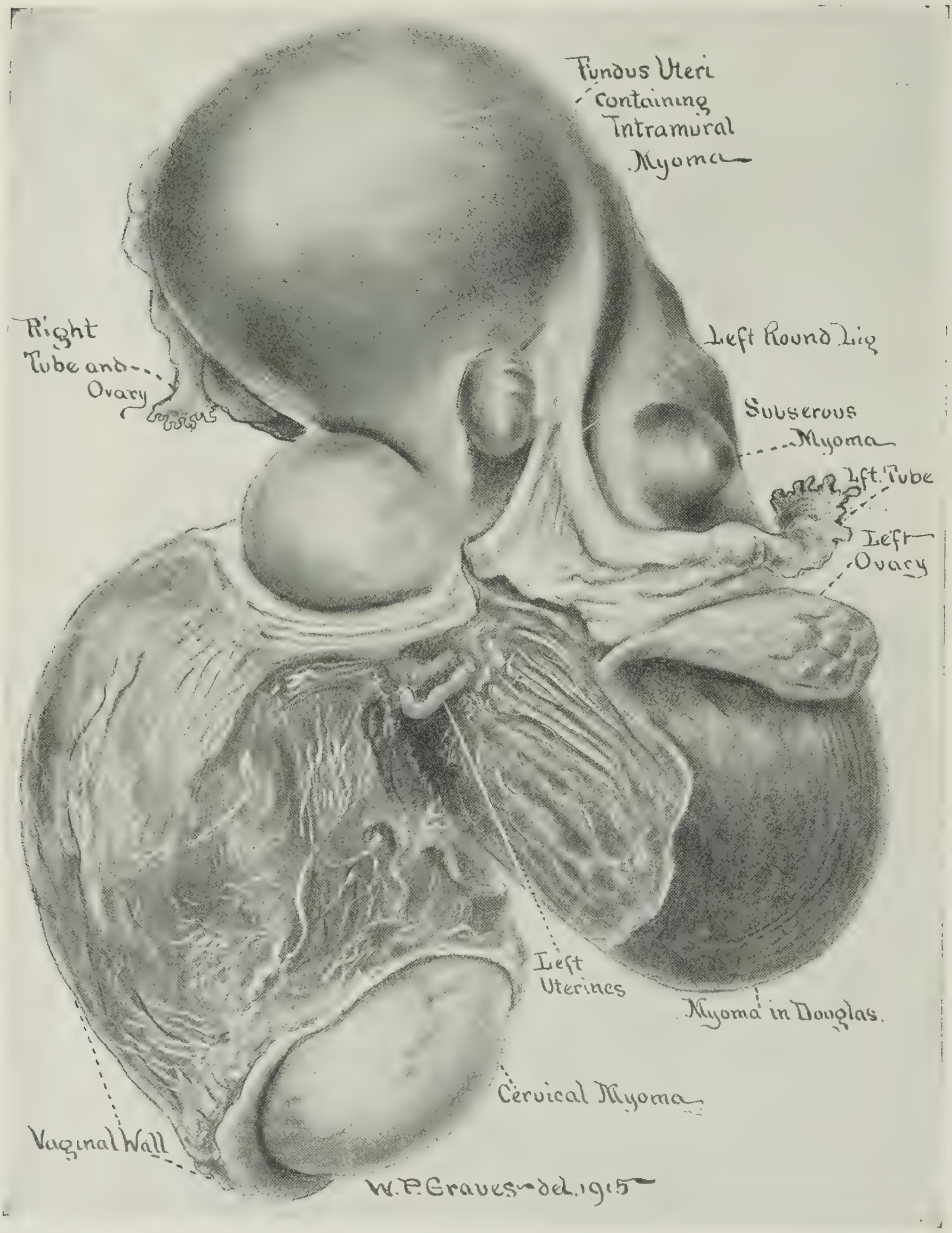


FIG. 101.—CERVICAL MYOMA.

The drawing is from a specimen removed by operation. The lower two masses represent two enormous cervical fibroids, one filling the pouch of Douglas and the other extending down into the vagina nearly to the introitus. The vaginal wall was removed during the operation and is seen in the drawing surrounding the lower myoma.

separated by the infiltrating serous fluid that they closely resemble microscopically true myxomatous cells. A better term for this change would be *myxomatoid* degeneration.

*Cystic degeneration* in some cases represents a still more marked serous infiltration by which the fluid exudate becomes confined in certain areas, so as to create cavities in the tissue of the tumor. Enormous cysts may form by the coalescing of smaller cysts.

Cystic formation in uterine fibroids also results from other causes than passive congestion. Changes in the blood- and lymph-vessels may produce cystic tumors of the angiomatous and lymphangiectatic type. In some of the large cystic myomata there is doubtless an abnormal secretory action on the

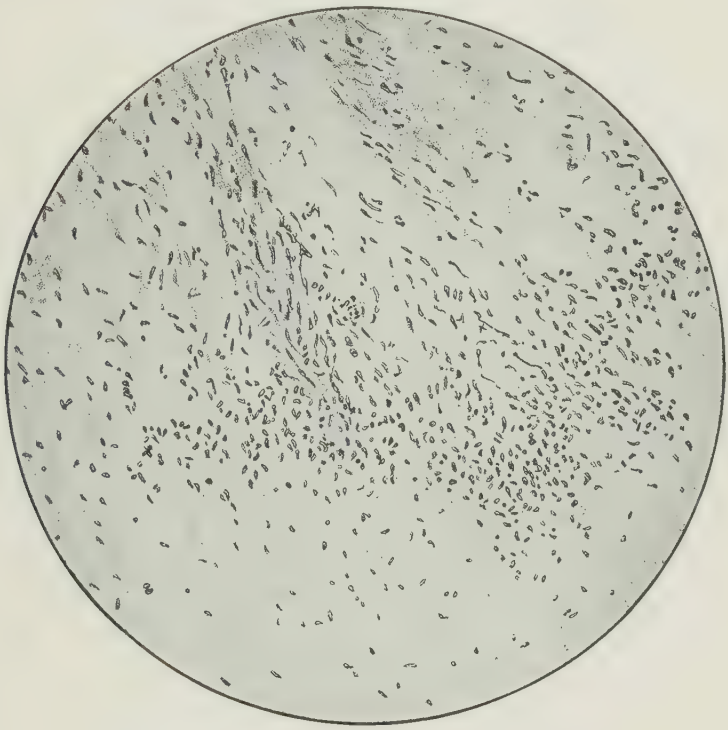

FIG. 102.—HYALINE DEGENERATION OF FIBROID.

part of the cells lining the cysts, such as occurs in the cystic change of adenomyomata. Cysts may also result from a local necrosis of the myoma with liquefaction of the tissues. This is sometimes seen in fibroids that have been treated by radiation. In some cases the cysts originate in the glandular elements of an adenomyoma.

*Red degeneration* relates to a form of degeneration characterized by a bright red color of the tissue. There are two types of red degeneration, the *thrombotic* and the *angiomatous*. The thrombotic type is especially common in tumors complicating pregnancy. These tumors degenerate rapidly and easily become infected. They usually grow rapidly and may be very painful and exquisitely tender to the touch. They are apt to be attended with fever and other constitutional symptoms.

The antiomagous tumors show free blood on the cut surface from numerous thin-walled blood-vessels. They are clinically less important than those of the thrombotic type.

*Fatty Degeneration.*—This form of degeneration takes place especially during pregnancy. Fat areas may be seen scattered throughout the tumor or the

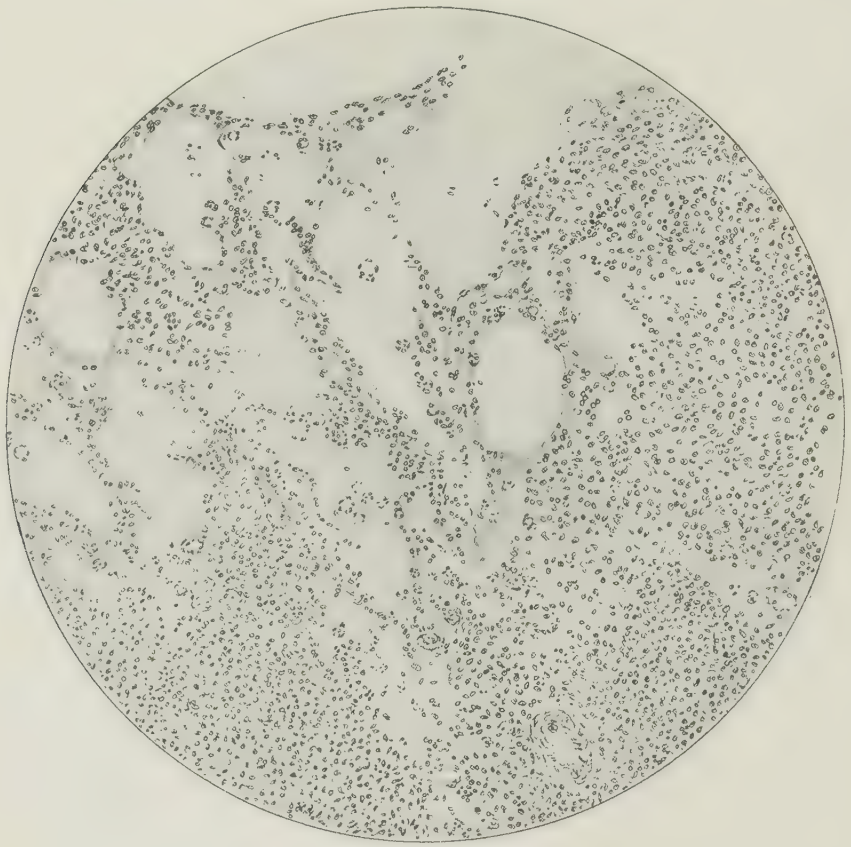

Fig. 103.—Fibromyoma with Cystic Degeneration.

Low power. The section contains irregular cavities which were filled with a thick, cloudy fluid. The section is taken from the edge of a large cavity, the condition being due to necrosis. The nuclei of the muscle-cells are cut in cross-section. There is a marked infiltration with leukocytes.

tumor may be almost entirely converted into fat. Fatty degeneration is also seen in atrophied fibroids following the menopause.

*Necrosis* of fibroids occurs when they become deprived of their blood-supply. This is apt to happen during pregnancy and constitutes a dangerous complication. Pedunculated fibroids may become necrotic as a result of torsion. Partial necrosis with cyst formation may occur without causing symptoms unless infection takes place. If the surface of the fibroid takes part in the necrosis the results are more serious, for the damaged peritoneum may cause adhesions to the intestines, and from this source there is greater danger of infection.

Red degeneration is also applied to the early stage of necrosis, especially that seen in connection with pregnancy. The necrosis begins in the center of the tumor. The myomatous tissue loses its elasticity, and, as a result of diffusion of the blood coloring-matter, becomes pink or flesh colored. As the necrosis progresses the color becomes brown and greenish. In the end the tissue sometimes becomes dry and crumpled or sometimes liquefied.

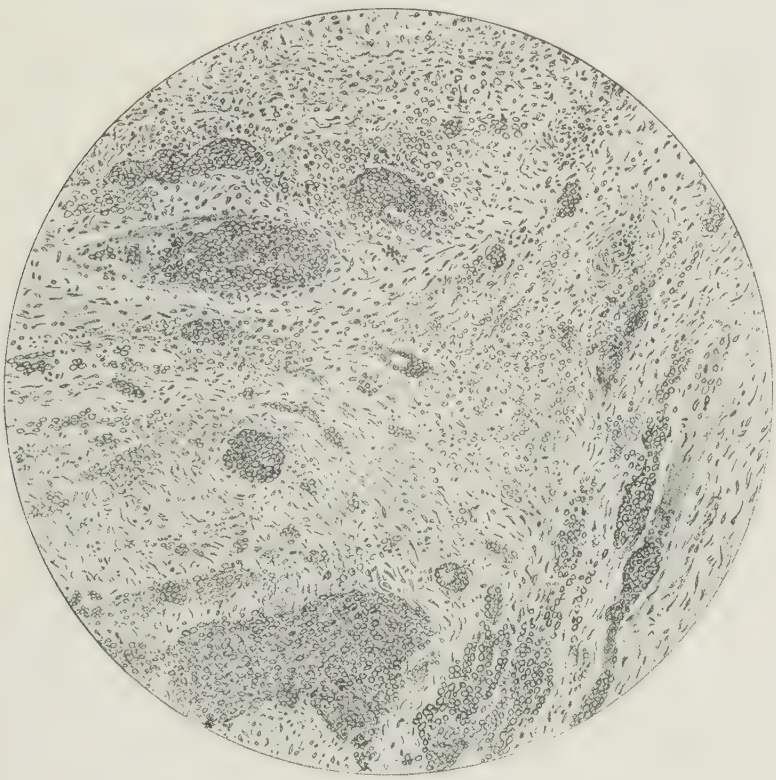

FIG. 104.—FIBROMYOMA WITH HEMORRHAGE.

Low power. Scattered through the section are masses of blood-corpuscles and single corpuscles. The blood-vessels, as can be seen near the center of the section, are dilated.

*Calcification* represents a deposit of lime salts in the tissue of the tumor. This occurs in long-existing fibroids, and is seen usually after the menopause. The calcified process may be in scattered areas or may involve the entire tumor. If there are multiple fibroids the calcification may appear in some of the tumors and not in others.

*Regressive Changes.*—After the menopause a change takes place in the tissue of the fibroid like that which occurs in the uterus. The change consists principally in a diminishing proportion of muscular to connective tissue. The connective tissue gradually loses its cellular elements and approaches cicatricial tissue in character. There is a consequent shrinking of the tumor bulk. This

atrophy of uterine fibroids has led to the belief that they disappear or are "absorbed" after the menopause. They probably never disappear.

Regressive or atrophied fibroid tumors are not to be regarded as beyond the pale of danger, for they are especially prone to various forms of degeneration.

Atrophy of fibroids is not entirely confined to the menopause, for it is sometimes observed during the puerperium.

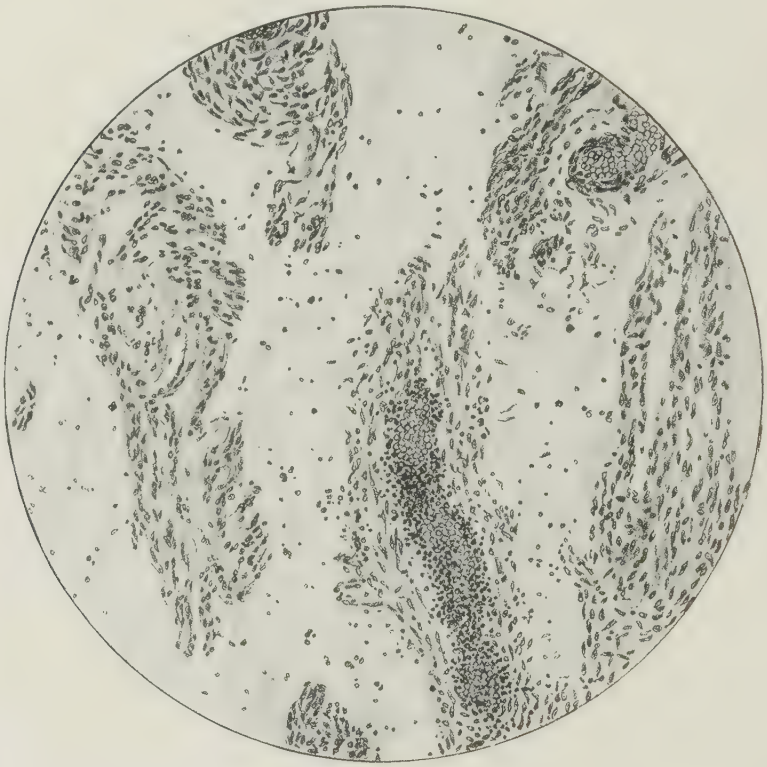

FIG. 105.—FIBROMYOMA WITH NECROSIS.

Low power. Much of the tissue has become necrotic, leaving material of a thick fluid consistency which has no definite structure microscopically, infiltrated with a few leukocytes. The myomatous tissue is preserved along the blood-vessels, as is well shown to the right of the drawing.

*Sarcomatous Change.*—The so-called malignant degeneration of fibroids occurs most commonly in long-existing tumors after the menopause. The change starts usually at some localized point near the center of the growth. The entire tumor may become involved and be the starting-point of distant metastases. There is a wide variation in the estimates of the frequency with which sarcomatous change takes place. This is most generally put at 5 per cent. More recent investigations with improved staining methods have demonstrated that many of the diagnoses are erroneous, and that the actual proportion is nearer 1 per cent.[1] (See also Sarcoma of Uterus.)

[1] Evans found 72 cases of malignant change in a series of 4000 uterine fibromyomata. For an excellent discussion of the subject the reader is referred to his article. (Surg., Gynec., and Obst., 1920, xxx, 225.)

In order to make an exact diagnosis between a myoma rich in cells and a myosarcoma Raab recommends the following points for consideration:

(1) Structure of the muscular tissue and its richness in cells; (2) changes in the nuclei; (3) division of the nuclei; (4) content of intercellular fibrils (hyaline); (5) giant-cells; (6) boundaries of the tumor.

Other important points are that:

1. Rich cell content and limited development of connective tissue cannot settle the diagnosis of myosarcoma, since ordinary myomata, rich in cells, may show the same condition.

2. The nucleus in myosarcoma does not show any decided change in form in contrast to that of ordinary myoma.

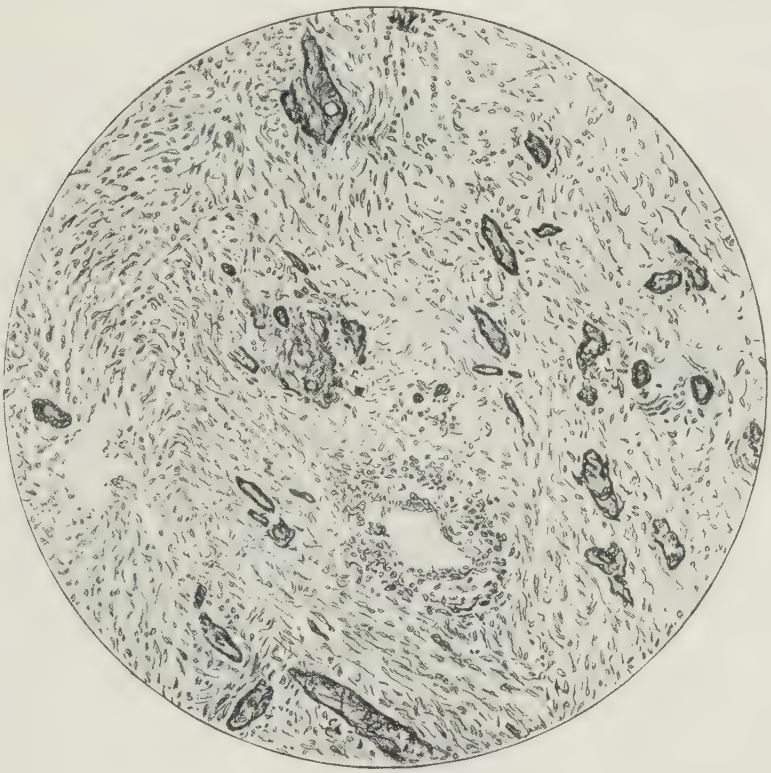

FIG. 106.—FIBROMYOMA WITH CALCIFICATION.

Low power. The darker areas scattered through the tissue are areas of beginning calcification. Their irregular outlines and deep staining properties are characteristic. The tissue on the right is poor in nuclei and consists largely of connective tissue.

3. The mere presence of division of nuclei cannot be taken as decisive. It is decisive only if abundant, and examination should be directed chiefly to the youngest parts of the tumor that have not yet undergone regressive metamorphosis.

4. Hyaline degeneration is more likely to take place in myomata and is perhaps to be regarded as a cicatricial process.

5. Giant-cells have a special value in the diagnosis of malignancy. They may appear very rarely in benign myomata, but if found, they are isolated. They appear in great numbers in myosarcoma and with especial abundance in the boundaries of the hyaline masses.

6. Benign tumors show sharply circumscribed boundaries. Myosarcomata do not show a real infiltrating proliferation, but a penetration into the lymph-vessels (Köhler).

Adenocarcinoma of the endometrium is not infrequently associated with myomata. This combination occurs more commonly in the large, long-existing tumors. It, of course, is not in any sense a carcinomatous degeneration of the fibroid, as the two processes are histologically entirely distinct. It is probable that the myomatous growth, acting mechanically as an irritant to the endometrium, encourages the malignant process.

FIG. 107.—FIBROMYOMA WITH CARCINOMA.

Low power. Most of the section consists of fibromyomatous tissue in process of necrosis, with an infiltration of leukocytes. Four areas of carcinomatous tissue are seen, the centers of two of which are necrotic. This area was found in the center of a polyp. The case is extremely rare.

In very rare instances a myomatous polyp of the uterus may become permeated with a carcinomatous growth. In a case operated on by the author a necrotic myoma was removed from the cervical canal in an elderly woman. The polyp, both macroscopically and microscopically, was that of a pedunculated fibroid about the size of an English walnut. Through portions of the tumor were found areas of squamous cell carcinoma, though there was no apparent trace of malignant disease in the cervical tissue. The disease later recurred in the parametrium. Von Winewater reported a very similar case (Arch. f. Gyn., 1912) in which there was an adenocarcinomatous invasion of a pedunculated myoma. In his case the uterus was removed. Although adenocarcinoma was found throughout the myoma, the uterine wall was entirely free from malignant invasion. He thinks that the disease originated in the pedicle of the myoma and spread into the tumor rather than into the uterine wall, following the lines of least resistance.

**Infection.**—Uterine myomata may become infected in several ways. Superficially they may take part in a pelvic peritonitis that results from a gonorrheal or puerperal infection. The inflammation in this case is confined to the peritoneal covering of the tumor and is manifested by adhesions. Necrotic myomata become adherent as a result of a damaged peritoneal covering. The injury to the peritoneum is caused by obstruction of the peripheral blood-supply.

Fibroids may also become adherent to peritoneal surfaces if the pressure is great enough or is exerted against hard surfaces so as to traumatize the serous membrane. A necrotic fibroid adherent to the intestines may result in serious infection and peritonitis, the path of infection being through the wall of the intestines. This is one of the special dangers that threaten fibroids associated with pregnancy.

Another form of infection is that which reaches the myoma through the general circulation. This has been proved by the finding of pathogenic germs in the tissues of fibroids and explains the elevated temperature which some myomatous women show. It must also explain many cases of acute pelvic inflammation which complicate uterine fibroids where gonorrheal and puerperal infection can be positively ruled out. These inflammations are sometimes very extensive, involving the adnexa and resulting in large pelvic abscesses.

Polypoid submucous myomata frequently become infected and gangrenous. Occasionally during the puerperium subserous myomata suppurate.

**Frequency.**—Uterine myomata occur with extraordinary frequency. At least 40 per cent. of all women have fibroids, while nearly all single women of middle age have them.[1] Only a certain percentage of the tumors, however, give trouble, many of them remaining entirely insignificant. It is rare to see fibroids in women under twenty-five years of age. Most tumors begin their growth between the ages of twenty-five and forty, and if they cause symptoms they become subject to treatment, most commonly between the ages of forty and fifty. After the menopause it is doubtful if new tumors ever develop. Thus, it will be seen that the origin of growth of fibroids parallels somewhat closely the child-bearing era. The rate of growth varies widely. Usually it is very slow, and it may take several years for a myoma to become large enough to attract attention. Occasionally one takes on a very rapid development, and it is tumors of this kind that have been frequently mistaken for sarcomata. The microscopic appearance of rapidly growing myomatous cells is very like sarcoma and can only be distinguished by expert examination. In many instances the apparent rapid enlargement of a fibroid is not due to an actual multiplication of the myomatous elements, but to edema or some form of degeneration or inflammation.

Fibroids associated with pregnancy usually enlarge, though they may

[1] Figures from the Mayo Clinic are considerably more conservative. To quote W. J. Mayo: "About 12 per cent. of white and 30 per cent. of colored women of fifty years of age have uterine myomata. Fifty per cent. of colored women of thirty-five years who have not borne children have such tumors."

diminish, in size. Sometimes there is a temporary enlargement, followed by a cessation of growth or even an atrophy. The enlargement of a fibroid after the menopause is always due to some form of degeneration.

**Symptoms.**—The symptomatology of uterine fibroids depends to a great extent on the location of the tumor. If favorably placed, a myomatous tumor may grow to a large size without giving the patient the slightest discomfort.

A subserous fibroid growing toward the abdominal cavity may be supported by the brim of the pelvis. By drawing the uterus with it, the fibroid, instead of causing pelvic pressure, acts in exactly the opposite direction, so that patients may carry one of these tumors for years without noticing it. In fact, many patients, feeling the hard lump in the abdomen, regard it as a normal part of their anatomy.

If, however, the tumor is so located as to cause pelvic pressure, symptoms ensue. Thus, a fibroid growing in the lower posterior wall of the uterus is more likely to exert downward pressure on the pelvic supports than one that is growing in the fundus. This downward pelvic pressure, in whatever way it is caused, represents one of the most important phases of all gynecologic symptomatology. The patient is almost continually conscious of a bearing-down discomfort, which, without giving actual pain, serves in time to become a serious drain on the general health. Patients with this symptom cannot be on their feet long without becoming tired. Working women become worn and exhausted, while the well-to-do are prevented from taking part in the various activities to which they are accustomed. The ill effect of pelvic pressure on the general nervous system is of great clinical importance, and must be borne in mind in considering the treatment of uterine fibroids.

Besides producing the effect of weight and general pelvic pressure, fibroids may cause other pressure symptoms. A tumor encroaching on the rectum may cause constipation. It does this partly by obstructing the lumen of the bowel and partly by interfering with the muscular peristalsis of the rectal wall. Occasionally an impacted myoma may entirely obstruct the bowel. Fibroids on the anterior wall of the uterus may cause symptoms of irritation of the bladder, though this occurs less commonly than one might suppose. They have been known to cause by pressure complete suppression of the urine. Tumors that obstruct the bladder usually develop from the cervix.

It is possible for a myoma to grow in such a way as to press on the sciatic nerve and cause pain in the leg. Large tumors are often attended with cyanosis and palpitation as a result of their size and weight.

Uncomplicated fibroids are not tender and ordinarily do not give pain, except occasionally in connection with menstruation.

Pelvic pain and tenderness usually signify an inflammatory process. If the process is active, the course is that of any pelvic inflammation. Painful and tender fibroid tumors, where there is no active inflammation, as a rule, indicate adhesions. A sudden acute abdominal attack is sometimes the result of torsion and demands immediate operation.

Interstitial fibroids are very apt to cause dysmenorrhea, while intermenstrual pain is a very frequent sign of interstitial growth.

The most important effect of fibroids is uterine bleeding in the form of menorrhagia. The catamenia is characterized by a more profuse flow, the appearance of clots in the menstrual blood, and a prolongation of the period beyond its normal limits. There is usually a shortening also of the intermenstrual period.

All three forms of these tumors may cause abnormal uterine bleeding, but it more commonly comes from the submucous or centripetally growing type. Centrifugal tumors may grow to an enormous size without producing menorrhagia. The continued menorrhagia of bleeding fibroids results in serious detriment to the patient's health. A secondary anemia always ensues and the hemoglobin may be reduced as low as 25 per cent. or even 10 per cent.

Besides the constitutional symptoms resultant on the frequent losses of blood, bleeding fibroids produce a very deleterious effect on the nervous system, especially if there be a neurotic predisposition.

A rare complication of uterine fibroids is rupture of one of the large surface veins that lie in the periphery of the larger fibroids just under the peritoneal covering. The symptoms are like those of any acute abdominal hemorrhage, such, for example, as that from an extra-uterine pregnancy or a perforated gastric ulcer. For a brief article on the subject see Ransohoff and Dreyfoos. (Surg., Gynec., and Obst., 1921.)

Polypoid submucous fibroids, besides causing menorrhagia, may also cause metrorrhagia. This is due to the fact that these tumors usually become necrotic and the intermenstrual blood comes from the macerated surface. Hemorrhages from this source may be very alarming. It should be remembered, however, that the bleeding from fibroid tumors is always venous, and, therefore, almost never fatal.

Necrotic polypoid submucous fibroids cause a foul leukorrheal discharge which in odor and consistency closely resembles that from cancer of the cervix.

There are certain changes that appear in other organs of the body with sufficient frequency in connection with fibroid tumors to have led to the belief that the growths bear some causal relationship to the associated condition. The principal secondary conditions in this connection are heart lesions, hyperthyroidism, and diabetes. Of these, heart lesions occur most frequently, and appear sufficiently often to have earned the appellation of "myoma heart." Disturbances of the heart are usually seen, either in connection with large long-standing myomata in women past middle life or where there has been long-continued menorrhagia and secondary anemia. The fundamental condition of the heart is that of compensatory dilatation, which usually rights itself after the removal of the tumor. If, however, the case is neglected the heart may lose its compensation (see also page 117).

**Fibroids and Pregnancy.**—The relationship between pregnancy and uterine myomata is a subject of much importance, for not only does pregnancy affect

the growth of the tumors in various ways, but the tumors exert a dangerous influence over the course of pregnancy.

Fibroids, as we have seen, may take on a very rapid growth during pregnancy. In this process the myomatous elements seem to share in the physiologic hypertrophy of the uterine wall. The enlargement of the myoma may be permanent or the tumor may become regressive after the birth of the child. Sometimes fibroids atrophy during pregnancy, but this is not the rule. The blood-supply of fibroids during pregnancy is usually diminished, especially if they are subserous or pedunculated, and this constitutes a very serious danger, for it may result in necrosis of the tumor and subsequent infection. Fatty degeneration of the tumors is one of the changes that take place during pregnancy.

Of the influences that fibroids exert on the course of pregnancy, abortion is one of the most common. It is probable that interstitial tumors disturb the muscular tension of the uterine wall, so that abnormal contractions occur sufficient to dislodge the ovum.

Submucous fibroids produce abnormal changes in the endometrium. It is thinned and flattened over the surface of the tumor, while the remainder becomes permanently hypertrophied. The endometrium may, therefore, become poor soil for the continued growth of the ovum.

Undoubtedly, fibroids to some extent prevent impregnation. This is denied by some, but authentic figures seem to show that the percentage of sterility in myomatous women is higher than in normal women. The average proportion of sterility in all women is between 12 and 15 per cent., while that in myomatous women is about 30 per cent. Just why a myomatous predisposition causes sterility is not known. On the other hand, it has been claimed that fibroids, by prolonging the menstrual era, sometimes favor fertility.

Myomata that are large or so placed as to obstruct the uterine canal may act as a serious interference to childbirth.

The relationship between myomata and the function of menstruation is a matter of interest. Women who develop fibroids are apt to give a history of having begun to menstruate at an especially early age. They also continue to menstruate to a later age than the average, the menopause coming at fifty or over. Myomatous women usually menstruate profusely from the time the catamenia is established, and clotting of the menstrual blood often occurs long before evidences of fibroid growth appear.

The **diagnosis** of uterine fibroids is, in the majority of cases, attended with little difficulty. The characteristic hard, nodular, asymmetric feel of the uterus is usually unmistakable; nevertheless, there are many chances for error.

In palpating the abdomen the most important sign is the ability to feel the fundus of the uterus just back of the pubes. In the absence of pregnancy this indicates a fibroid uterus in the vast majority of cases, though it must be remembered that it may result from a tumor of the adnexa in the posterior culdesac, which is pushing the uterus forward toward the anterior abdominal wall. An

adherent tumor of this kind, whether of the ovary or of the Fallopian tube, creates with the uterus a mass which is often mistaken for a fibroid uterus, a mistake in diagnosis that may be made by the most expert. The error, however, is not serious, for if there are symptoms, either condition indicates an abdominal operation.

A well-advanced cancer of the body of the uterus is often difficult to distinguish from a symmetric edematous fibroid. If there has been metrorrhagia, suspicion of cancer should be aroused, and it is advisable to make a preliminary intra-uterine examination, with removal of a specimen for microscopic diagnosis. This is important, since even after the abdomen is opened it may not be possible to distinguish between the two conditions. A correct diagnosis is essential, because if the tumor is a fibroid, supravaginal hysterectomy is indicated, while if it is cancer of the body, a complete hysterectomy, preferably by Wertheim's method, should be performed.

The diagnosis between pregnancy and a myomatous uterus is sometimes exceedingly difficult and may lead to disastrous procedures. A symmetric edematous myoma may resemble a pregnant uterus very closely indeed. When there is doubt between these two conditions, the most reliable help is from the history of menstruation. Pregnancy causes amenorrhea and fibroids tend to cause menorrhagia, yet it must be borne in mind that pregnant women sometimes bleed periodically, while fibroids occasionally are associated with temporary amenorrhea. Other incidental signs are helpful. Of these, the consistency of the cervix is most valuable. The cervix of a myomatous uterus does not exhibit the softness characteristic of pregnancy. If, however, there is a severe laceration with eversion of the lips, the sign may be doubtful. The condition of the breasts, the presence or absence of blueness of the vaginal mucous membrane, are incidentally valuable. If on opening the abdomen doubt still exists, something can be told from the color of the uterus. A myomatous uterus has rather a pinkish hue, while that of the pregnant one is a deep purple. If doubt still exists, it is best to incise the uterine wall in a longitudinal direction, by which a certain diagnosis can be made at once. The corpus luteum sometimes indicates the real condition, but is not entirely reliable. If it is very large, it throws additional evidence in favor of pregnancy.

The use of the uterine sound, formerly so commonly used in the diagnosis of uterine myomata, is not recommended under any condition. The information gained from it is of little value, while the dangers in its use are considerable. The Abderhalden test for pregnancy is especially valuable in differentiating fibroids from pregnant uteri.

A more recent method of differentiating pregnancy from fibroids is by the *x*-ray after transperitoneal gas inflation. Carbon dioxid is forced into the abdominal cavity through a paracentesis needle by means of a special apparatus (that devised by Rubin is especially recommended). The pneumoperitoneum thus produced enables the roentgenologist to obtain a clear picture

of the pelvic organs. (For a description of this method the reader is referred to the work of Reuben Peterson, Surg., Gynec., and Obst., 1921.)

The **treatment** of uterine myomata depends on their size, rapidity of growth, and the production of symptoms. Many fibroids require no treatment at all. Small subserous tumors that are either stationary or growing very slowly, and which are causing no symptoms, may be left alone, but should be kept under periodic observation, especially if the patient is likely to become pregnant. Atrophied fibroids of moderate size after the menopause do not need treatment if they are giving no symptoms, but should be carefully watched for evidences of degeneration.

Large fibroids, when discovered, should, as a rule, be removed even if they are causing no discomfort, for they are practically sure to give trouble sooner or later and their removal is safer and easier if it is done before serious symptoms or complications take place.

Fibroids that cause symptoms should in most cases be treated surgically. The symptoms that require surgical intervention are those that result from bleeding, pressure, infection, and degeneration. It is obvious that symptoms from the last three conditions named can only be treated by surgical operation.[1]

Bleeding, however, when not due to degenerative processes in the tumor, may be subject sometimes to other forms of treatment than surgery. As we have seen, the bleeding from a submucous myoma comes from the hypertrophied endometrium not covering the tumor. It is, therefore, possible sometimes to relieve the menorrhagia by curetment. The relief is, however, usually only temporary. The procedure is especially useful in tiding a patient over the menopause, with the hope of a future atrophy of the tumor. This form of treatment is to be used only in small or moderately sized fibroids.

There are various drugs that are in common use for treating menorrhagia due to fibroids, most prominent of which are ergot, hydrastis, and hamamelis. The results of their use are, however, very unsatisfactory. Recently pituitrin has come into favor, and encouraging reports have been made in its administration for the control of non-puerperal uterine bleeding.

**Treatment of Fibroids by Radiation.**—The *x*-ray and radium are being used extensively for bleeding fibroids. Of these two methods, radium is preferable, as it is surer in its results, requires as a rule only one application, and avoids the possibility of a burn. In a successful case bleeding is stopped, the menopause is artificially established, and the fibroid mass is greatly reduced in size. This form of treatment has a restricted field of usefulness and should be employed with great care. We do not advocate radiation for large fibroids excepting in

[1] The following summary by W. J. Mayo is of practical value. "The most common conditions indicating operation are those which result from: (1) hemorrhage; (2) degeneration of the tumor (22 per cent.); (3) malignant disease, usually carcinoma of the body of the uterus (4 per cent.); 10 per cent. of women more than fifty years of age who come to operation for uterine myoma have complicating malignancy; and (4) tumors causing pressure. The great majority of patients who have tumors extending above the pubes belong to this group. It has been shown that in 30 per cent. of patients with myomata of the uterus which cause symptoms, the ovaries and tubes are seriously diseased, and often require operation independent of the myomata."

patients who are constitutionally unfit for surgical operation. This includes patients in whom the bleeding has caused an extreme secondary anemia. It should be remembered that an effectual retardation of the growth and activity of a fibroid can be attained only by a dosage of radium sufficient to bring about a permanent menopause. Radiation should, therefore, be employed sparingly during the childbearing period, myomectomy being the procedure of choice whenever possible. If the tumor mass is too large or the myomata too numerous for myomectomy, hysterectomy is usually preferable to radiation. Pedunculated submucous fibroids do not react well to radiation, and usually require a later operation. Necrotic fibroids or fibroids that are undergoing any form of degeneration should not be treated by radium. The most important contraindication to the radium treatment of fibroids is pelvic inflammatory disease of any kind, whether acute or chronic. This includes all cases in which pelvic adhesions are present even if the origin of the adhesions has not been of an infectious character. Examples of this are adhesions from pressure necrosis, or from hemorrhagic (chocolate) cysts of the ovaries. Radium applied to the uterus in the presence of such pelvic diseases may produce the most serious, often fatal, infections of the pelvic cavity.

The chief field of usefulness for radium in the treatment of fibroids is in the case of small or moderate-sized tumors that are causing excessive bleeding in women who are approaching the menopause.

Fibroids that cause bleeding after the menopause, or after the menopause is due, should, as a rule, be subjected to operation unless the tumors are small and it can be established beyond question that no malignant, degenerative or inflammatory process is present.

When radium is used for fibroids associated with bleeding before the menopause, it should be borne in mind that a single application is not as frequently successful as in cases of simple uterine insufficiency. Thus it occasionally happens that after this first dosage there is only a temporary cessation of bleeding for a few months. During that time there is a marked diminution in the size of the tumor. External genital atrophy ensues, and typical hot flushes are experienced. In the course of time the hot flushes cease, the external genitals resume their natural appearance, the tumor regains its original size, and menstruation with its excessive flow is reëstablished. Under such conditions a second dose is required and is generally successful unless the fibroid in question is unfavorably situated, as in cases of submucous tumors growing into the uterine canal. If a second application is unsuccessful, operation is usually desirable.

In our practice the average dosage employed in fibroid cases with bleeding is from 1200 to 1500 mg. hours. The immediate after-results of the radium treatment of fibroids are the same as those following the treatment of uterine insufficiency (*q. v.*), and of these the patient should always be warned. The possibility of bleeding at the first two menstrual periods following treatment is especially pronounced and is sometimes excessive even in cases that are eventually cured.

(See also Radium in the Treatment of Non-malignant Gynecologic Diseases.)

*Myomectomy and Hysterectomy.*—The surgical treatment of uterine myomata consists either in the enucleation of the tumor, myomectomy, so-called, or in the removal of the uterine body by a supravaginal hysterectomy.

Small tumors that are met with incidently during a pelvic operation should always be removed by myomectomy as a routine, unless they are so numerous or deep seated that this operation is not feasible.

It is often possible to encleate symptom-giving tumors of considerable size, and the question not infrequently arises as to which operation is advisable. This question must be decided very much as is the question of conservatism or radicalism in chronic pelvic inflammation. One must first weigh the comparative merits of the two operations. If the myoma is of considerable size and not well pedunculated, a myomectomy is a bloodier and more difficult operation than hys-

terectomy. The immediate convalescence from extensive myomectomy operations is apt to be very stormy, while that from hysterectomy is unusually good. Moreover, the removal of one or more fibroids from the wall of the uterus does not insure against the development of others at some later date. In young women the chances of recurrence are very considerable. Myomectomy operations, owing to the exposure of wound edges and suture knots, are more often followed by postoperative adhesions than are hysterectomy operations. Thus, it will be seen that myomectomy has certain disadvantages which often make the procedure inadvisable. There are, however, circumstances under which the operation must be performed if it is surgically possible to do so. The most important indications for its use are in young women who wish to bear children, and in those who for sentimental reasons prefer the ill chances of a myomectomy to the loss of pelvic organs. Women in the child-bearing period who have had a myomectomy performed should be periodically examined until after the menopause.

The above paragraph, written for the original edition of this book, is purposely left unrevised, although the author's views have changed considerably as to the value of the myomectomy operation. Influenced by the recommendations of Dr. Will Mayo, the author has resorted to myomectomy much more frequently than formerly in women of the child-bearing age, and has found that many cases in which it had been customary to perform a hysterectomy were amenable to a myomectomy operation, with favorable results. An extensive enucleation of fibroids, attended as it is with mutilation of the uterine body, is an operation that requires skill and experience for its proper performance. The greatest care must be exercised in controlling the bleeding and in approximating the wound edges of the uterine wall so as not to leave a shallow scar that may be a source of danger of rupture in the event of a later pregnancy.

Most fibroids that require operation are best treated by a supravaginal hysterectomy by the abdominal route. The abdominal route has so many advantages over the vaginal that the question hardly needs discussion. It may be said, however, that the chief advantage of the former is that it is possible to secure a much more efficient postoperative pelvic support, a point that far outweighs all other considerations.

A supravaginal operation is preferable to a complete hysterectomy, partly because it is a simpler and safer operation, and partly because by leaving the cervix better pelvic support can be secured.

The only advantage that a complete hysterectomy has over supravaginal amputation is the avoidance of a possible future carcinoma of the remaining cervical stump. This complication does occur, but it is extremely rare. It is safe to say that if a complete hysterectomy were performed in every case as a routine the increased operative mortality would be considerably greater than the incidence of cancer following supravaginal amputation.

The technic of supravaginal hysterectomy is described in detail on page 761. The chief points to aim for in performing the operation are to secure permanent pelvic support and to avoid the possibility of postoperative adhesions. If these

two objects are attained the after-results of hysterectomy for fibroids are excellent, and are especially remarkable in those cases where there have been associated nervous disturbances.

The question of leaving in one or both ovaries when possible is one about which there is considerable disagreement. It is doubtful if leaving in ovarian tissue does very much good.

Among the opinions of those who favor ovarian conservation, we recommend especially those of J. G. Clark and C. C. Norris, whose views have been set forth in a recent article. Though admitting that the removal of both ovaries during a hysterectomy may be followed by good results, they urge the preservation of one or both ovaries if no ovarian disease is present, and if the ovary or ovaries can be left in normal position and with no injury to the blood-supply. They claim that patients when treated thus suffer less in general from menopause symptoms, genital atrophy, sexual disturbance, and neurotic symptoms. Nor have they encountered later trouble with the conserved ovarian tissue. Inasmuch as our personal experience has not tallied with that of Dr. Clark in any one of these particulars, it seems at least possible that so far as postoperative symptomatology goes there is no very great difference between the two methods. If that be true it would be reasonable to judge the question from the fate of the conserved tissue. We have encountered numerous cases in which the conserved organ gave later trouble of a serious nature amounting in several instances to fatal malignant disease.

Polypoid myomata are removed per vaginam. If they have a firm pedicle they can be removed with blunt-tipped scissors, preferably under an anesthetic, as the bleeding is sometimes troublesome. Some of the necrotic myomata can be removed by the finger without anesthesia, a point that is useful to remember in treating elderly women, in whom these necrotic fibroids very frequently appear.

### ADENOMYOMA

Adenomyomata constitute a special type of uterine fibroids. They are distinguished from the ordinary myomata by the diffuse manner in which they grow in the uterine wall, and by their containing embedded in the myomatous tissue numerous gland-like structures. These glands are lined by epithelium very similar to, and probably, for the most part, identical with, that of the endometrium, while immediately surrounding the glands is a cytogenous connective tissue like that of the endometrial stroma.

The origin of the adenomyomata is a matter of much scientific interest. As a result of the investigations of von Recklinghausen, it was believed for a time that they all develop from rests of the Wolffian body. von Recklinghausen demonstrated structures in some of his specimens resembling the convoluted tubules and glomeruli of the kidney. Later researches, especially by R. Meyer, Cullen, and Opitz, have shown that in most instances the glandular elements are developed from and connected with the glands of the mucosa. Meyer has also shown that in some of the small subserous tumors the epithelial structures are derived from the peritoneal epithelium of the surface of the uterus. It is conceded that only one form of adenomyoma, that which grows in the parametrium, is probably derived from embryonal rests.

The adenomyomata, for the most part, develop in the posterior wall of the

uterus, more commonly near the uterine horns. They may, however, grow in any part of the uterus and even rarely in the cervix. Occasionally they form polypoid tumors in the uterine canal. They do not attain large dimensions, rarely reaching a size greater than that of an orange. On account of the diffuse nature of their growth it is often difficult to distinguish the boundary line between tumor and uterine wall, especially if the tumor is located near glandular tissue, as in the case of adenomyomata at the uterine horns. In fact, many of the so-called tumors of this region are pronounced by Meyer not true tumors

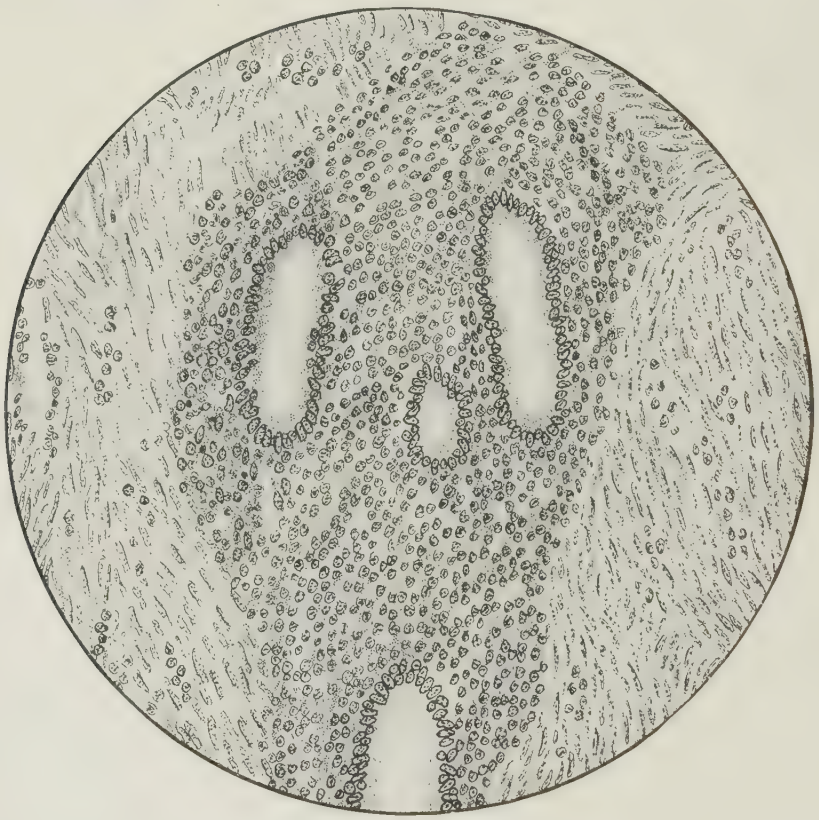

FIG. 108.—ADENOMYOMA.

High power. Sections of four glands are seen, lined by a single layer of epithelial cells. These lie in a connective-tissue stroma like that of the endometrium. The whole is surrounded by myomatous tissue in which are a few mononuclear leukocytes.

at all, but inflammatory hypertrophy of the uterus, a condition to which he gives the name of "adenomyositis." It has also been shown that adenomyomata are frequently associated with, and probably caused by, chronic pelvic inflammatory processes, in which tuberculosis plays an important part.

The adenomyomata are not, as a rule, of great clinical importance. They do not often grow to a size large enough to produce serious symptoms unless the tumor is a polypoid growth into the uterine canal.

The symptoms of adenomyomata are menorrhagia and menstrual pain referred to the uterus. Cullen, who has made an exhaustive study of these tumors, regards the clinical diagnosis of the condition as not difficult.

The adenomyomata have no special disposition to carcinomatous change, though this does occur in rare instances.

Author's Note (Third edition, 1923). New interest in uterine adenomyomata is furnished by Sampson's work on the hemorrhagic cysts of the ovary. He has shown that the endometrial implants that are sown in the pelvis by the perforation of these cysts may invade the uterine wall from the peritoneal side.

1. The generally recognized group in which the growth has apparently arisen from an invasion of the uterine wall by the mucosa lining the cavity, namely, invasion from "within" the uterus.

2. "Adenomyoma" arising from the invasion of the serous surface of the uterus by adenoma of the endometrial type secondary to adenoma of the ovary, namely, invasion from "without" the uterus. Histologically the two tumors are identical. The advanced stage of the latter may very closely resemble the former in its gross appearance. It is presumably possible for the adenoma arising on the surface of the uterus to penetrate the entire wall and even reach the mucosa lining the uterine cavity (Sampson).

## SARCOMA OF THE UTERUS

Sarcoma of the uterus is far less common than uterine cancer, the relative proportion of frequency being about 1 to 40. These tumors always arise from the connective tissue of the uterus, and may have their origin either in the connective tissue of the myometrium or in that of the mucous membrane. They are divided into two important classes, according to these two points of origin. Those that develop in the myometrium almost invariably represent a malignant change in a pre-existing fibromyoma—so-called malignant degeneration of fibroids. This type, termed *myosarcoma*, is stated by Meyer to be far more common than that which arises from the mucous membrane.

Myosarcoma of the uterus, for the most part, is an affection of middle age, the highest incidence occurring at about forty. Sarcoma from the mucous membrane appears relatively earlier, the youngest case reported by Döderlein being five years ,while the youngest case of myosarcoma reported was twenty.

The etiology of sarcoma of the uterus is quite obscure.

*Sarcoma of the Mucous Membrane.*—Macroscopically, sarcoma of the mucous membrane may be diffuse or polypoid. In the polypoid form masses of pedunculated tumors become extruded through the cervical canal, and either slough off spontaneously or are removed by operation, only to appear again. These constantly recurring tumors are sometimes called recurrent fibroids until a microscopic examination reveals the true nature of the growth (Fig. 109). Where this type of sarcoma springs from the mucosa of the cervix the vagina becomes filled with a mass of grape-like polyps, which eventually protrude through the introitus into the outer world. The tumor under these conditions is commonly called a grape-mole or sarcoma botryoides.

Diffuse sarcoma of the endometrium spreads into the wall of the uterus peripherally in the same manner as an inverting adenocarcinoma of the body.

*Myosarcoma.*[1]—Sarcomatous degeneration of fibroid tumors—myosarcoma—usually starts near the center of the growth. It may appear as a sharply defined nodule or it may spread diffusely in the surrounding tissue. Various forms of degeneration are apt to take place, so that, macroscopically, the sarcomatous portion of the tumor is sometimes distinguished from the normal tissue by discolored appearances, necrosis, or accumulation of fluid.

FIG. 109.—GRAPE SARCOMA, OR SARCOMA BOTRYOIDES.

The vagina is seen crowded with grape-like masses of the growth. (Copied from a drawing in Kustner's Handbuch.)

*Mixed Tumors.*—Mixed tumors of mesodermal character arise from the mucous membrane of the body or cervix. Histologically these tumors show besides sarcomatous cells such foreign tissue as cartilage and striped muscle. They are malignant, those from the endocervix being more so than those from the endometrium. As is true of other malignant growths in these structures, the tumors are often botryoid in appearance, especially when they have grown sufficiently to extrude into the vagina. According to Perlstein, the tumors of the cervix occur mainly in the prime of life, while those from the uterine body are more frequent at the menopause. Histogenetically these tumors are of the teratoid group, their location being explained only by the vague phrase "misplaced embryonal tissue." In this connection we would call the reader's attention to the possibility of germinal epithelium implantation (see section on Ovarian Epithelium).

**Histology.**—The cells of which the uterine sarcomata are made up are considerably varied. Meyer divides the growths into muscle-cell sarcoma (in which muscle cells and sarcoma cells are mixed), spindle-cell sarcoma, and round-cell sarcoma. The cells may be of all kinds and sizes. Sarcomata of the endometrium are chiefly characterized by round cells.

The latter type of sarcoma (especially the diffuse kind) is sometimes differentiated with difficulty from adenocarcinoma of the body, which in the advanced stages loses its glandular characteristics, the appearance and arrangement of the cells appearing quite similar to round-cell sarcoma. On the other hand,

[1] Williams divides sarcomata that develop in fibroids into *myosarcoma* and *myoma sarcomatodes* according to whether they originate in connective tissue or in the muscle, respectively.

the cells of diffuse sarcoma of the endometrium may assume an alveolar arrangement which closely resembles an adenocarcinoma. This is sometimes called "adenosarcoma." In some cases there is a rich development of blood-vessels or lymph elements, and the tumors are termed "angiosarcoma" or "lymphosarcoma." Melanosarcoma of the uterus has been described. Cystic degeneration of the tumors has led to the designation "cystic sarcoma."

It is possible for sarcoma and carcinoma to coexist in the same uterus.

**Diagnosis.**—An accurate clinical diagnosis of sarcoma of the uterus is, in the majority of cases, very difficult to make. In the polypoid type, where the

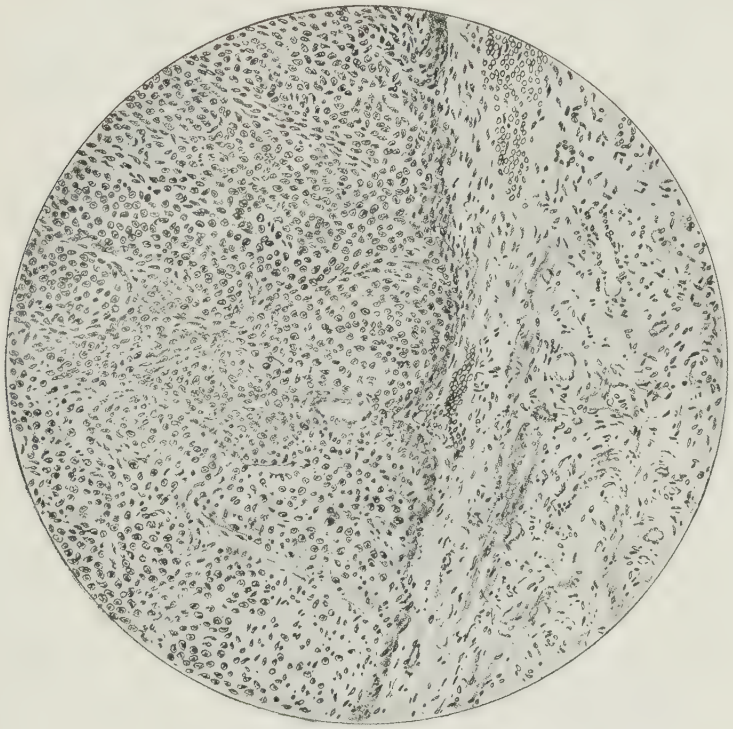

FIG. 110.—SARCOMA OF THE CERVIX.

Low power. This drawing shows the sharp line of demarcation between the growth on the left and the cervical stroma on the right. The latter consists of connective tissue with a few bundles of muscle scattered through it. The former consists of a homogeneous mass of cells very nearly the same size, having circular vesicular nuclei. There is very little stroma between the masses, and they are traversed by a fine network of capillaries, as can be seen in the drawing. In the center is a blood-vessel running into the tumor tissue from the cervical stroma.

tumors present in the vagina, the removal of a section for microscopic examination can easily be done. The so-called recurrent fibroids are almost pathognomonic of sarcoma, but the specimens removed or expelled should receive microscopic examination. In the less obivous forms of sarcoma the diagnosis is very blind, and is usually not definitely made except by the microscope, after operation or autopsy. There are, however, certain symptoms which may lead to suspicion of sarcoma, and of these uterine bleeding is the most important.

In children before puberty, bleeding from the vagina, if precocious menstruation is excluded, must be regarded with grave concern, for it is apt to indicate the presence of uterine or vaginal sarcoma. In later life all bleeding and sloughing myomatous polyps should receive searching microscopic examination. Diffuse sarcoma of the uterine mucosa occurring during menstrual life presents practically the same symptoms as adenocarcinoma of the body, chiefly metrorrhagia and foul discharge. The diagnosis should be made in the same way, namely, by removal of a specimen for microscopic study, preferably under an anesthetic, and preliminary to operation.

Where the sarcoma represents a malignant degeneration of a myoma the diagnosis can rarely be made positively. Many times these sarcomata are discovered only during the routine examination to which all fibroids should be subjected. During menstrual life menorrhagia and rapid increase of a myomatous uterus give warning of malignant degeneration, but these symptoms are, of course, not pathognomonic, as fibroids often take on sudden and rapid increase without the stimulus of malignant change. After the menopause the appearance of blood and sudden enlargement of a long-existing myoma are very suggestive signs of sarcomatous change, but they may also be caused by other forms of degeneration.

The appearance of ascites, together with rapid growth of a fibroid tumor, is a warning of sarcomatous change, for it rarely occurs in connection with nonmalignant fibroids. Loss of weight and cachexia are also important symptoms suggestive of sarcoma.

Estimates of the frequency with which sarcomatous degeneration takes place in fibroids vary from less than 1 per cent. to over 10 per cent. This wide difference is due to errors in microscopic diagnosis, for in many instances rapidly growing myomatous tissue resembles sarcoma so closely that a correct differential diagnosis can be made only by the most expert. The true incidence of sarcomatous degeneration of uterine fibroids is probably between 1 and 2 per cent.

Sarcoma of the uterus has a much greater tendency to metastasize to distant parts of the body than does cancer, either of the body or of the cervix, and for this reason it must be regarded as especially malignant. The tendency to metastasize varies somewhat according to the special type of sarcoma. The most dangerous form is the diffuse sarcoma of the endometrium which metastasizes very early. Somewhat less malignant is the polypoid type, while the most favorable is the sarcoma of uterine myomata.

This last-named group is apt to be very treacherous, however, for sometimes a small and inoffensive localized area within a myoma may be followed after removal by extensive metastases and death.

The **treatment** of sarcoma of the uterus consists, if the case is operable, in a total extirpation of the uterus, preferably by the Wertheim method.

In inoperable cases there is not much that can be done. Radium and *x*-ray treatment is, for the most part, ineffectual, and is positively contraindicated

in degenerated myomata, for by this means the malignant disease may often be stimulated to new activity.

**Endothelioma and Perithelioma.**—Endotheliomata of the uterus are comparatively rare tumors, but are frequently overlooked even by the pathologist. Arising as they do from endothelial cells they are to be classed with mesoblastic new growths and are, therefore, of the sarcoma family. They are divided from a histogenetic standpoint into true endotheliomata and peritheliomata. The former arise from the endothelial cells that line the blood-vessels and lymph-spaces. Peritheliomata have their origin in the endothelial cells that surround the adventitia of the blood-vessels. The histologic pathology and the differentiation between these two tumors is too complicated to be here given. (The reader is referred to an article by W. A. N. Dorland, Surg., Gyn., and Obst., November, 1916, which contains a résumé of the subject with an exhaustive bibliography.) The endotheliomata and peritheliomata may grow from the uterus or cervix or from a pre-existing myoma. The average age incidence is much later than that of sarcoma. The symptomatology is that of other malignant uterine tumors. This disease spreads by extension and has little tendency to metastasize.

## CERVICAL POLYPS

Cervical mucous polyps occur with extraordinary frequency. They are seen most commonly in women after forty, though they may appear earlier. They are very frequent after the menopause.

The cervical polyp represents a hypertrophy of the mucous membrane of the endocervix and contains all the elements of that structure. It usually has a slender pedicle, so that the polyp can easily be plucked off. Sometimes the polyp is sessile, with a broad base. These growths never reach a large size and are *more often multiple than single*. They are of a brighter red or purple color, and can usually be felt by the examining finger as soft movable bodies at the ring of the external os. They may grow in any portion of the cervical canal. When one is seen extruding at the external os there are usually others higher up in the canal.

They are composed of hypertrophied cervical mucous membrane, the glands being dilated and cystic, filled with a clear mucus. When grasped with an instrument they easily rupture and collapse. These small tumors have no tendency to become malignant. They are, however, by no means harmless and are sometimes of considerable clinical importance.

**Symptoms.**—The chief symptom is bleeding. Polyps may evidently exist for long periods of time without making themselves known. As a rule, the bleeding is rather mild in character. There is apt to be an increase of menstrual flow with slight signs of blood between the periods. If the menopause is past, the bleeding usually shows as a slight staining on the underclothing. Sometimes, however, even a small polyp may be the cause of profuse and exhausting

hemorrhages. Patients not infrequently acquire a pronounced secondary anemia from their presence.

Mucous polyps often set up a very persistent leukorrheal discharge. They easily become eroded and infected and maintain an inflammation of the endocervical mucous membrane. Often leukorrhea is the only symptom of their presence.

The **diagnosis** of cervical polyps is very important, for they produce symptoms very like those of malignant disease. In most cases they can be felt and

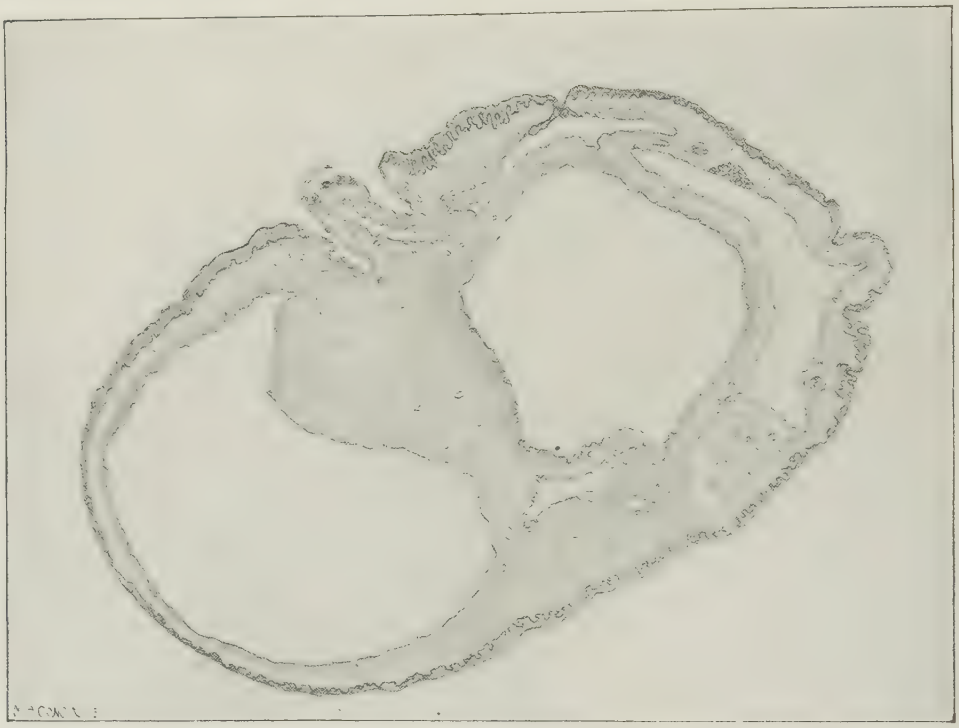

FIG. 111.—CERVICAL POLYP.

Cross-section of a polyp. The epithelium covering the polyp is of the stratified squamous variety, showing that this part of the polyp lay in the vagina. The spaces are dilated glands lined by a single layer of cylindric epithelium similar to that of the cervical canal, where the polyp originated. The stroma consists of connective tissue with a few muscle bundles in it.

seen, even if they are growing part way up the cervical canal, for they usually cause the external os to be more patulous than normal. In fact, in the presence of the above-named symptoms an abnormally patulous os leads one to suspect polyps, even if they are not at first apparent. The macroscopic appearance of a pedunculated polyp is quite characteristic and could rarely be confused with anything else. The sessile variety which grow well up in the cervix might suggest cancer. Microscopically, the picture is invariably that of hypertrophied endocervical mucous membrane. The larger polyps may sometimes be mistaken for degenerated polypoid myomata and should be carefully differ-

entiated from them by the microscope, because the latter may sometimes be malignant (adenomyomata, "recurrent" fibroid). The diagnosis of cervical polyp cannot always be made by digital examination and inspection, but may require anesthesia and an intra-uterine examination. With symptoms of irregular bleeding the possibility of cervical polyps must not be overlooked, for it is very easy to miss them during an intra-uterine examination if the upper part of the cervical canal is not carefully investigated with curet and polyp forceps.

The **treatment** of cervical polyps is always removal. The pedunculated polyps at the external os can easily be removed through a speculum by snipping

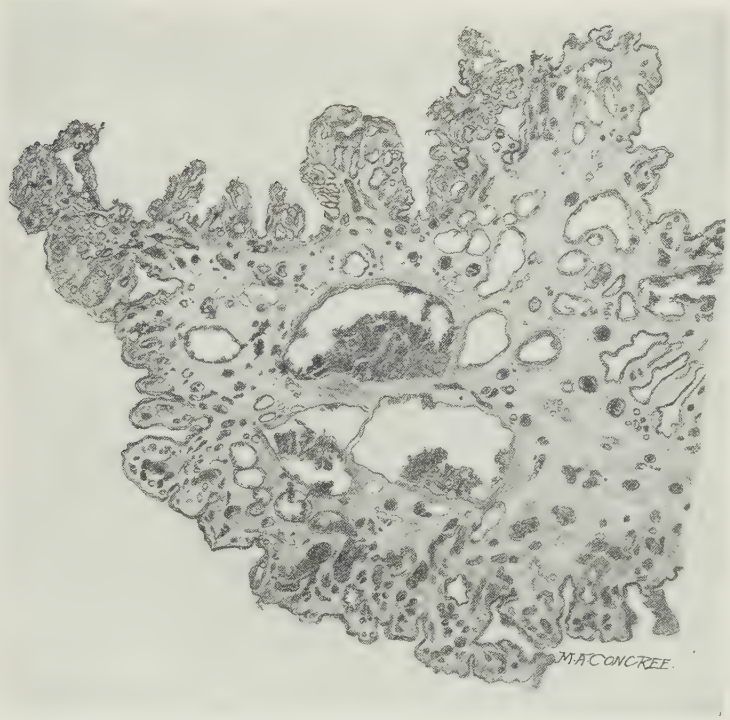


FIG. 112.—CERVICAL POLYP (MUCOUS).
(Low power.)

them off with scissors, and it is a temptation to do this in the office. It is always better to advise anesthesia and a complete intra-uterine examination, for in the majority of cases one or more small, beginning polyps can be found higher up in the cervix in addition to the one that is apparent. It is also important to curet thoroughly the canal of the cervix, for in most cases there is an associated endocervicitis which is very apt to persist after the removal of the polyp. As a rule, cutting off these growths causes very little bleeding. The sessile variety sometimes needs dissection and the placing of two or three fine catgut sutures in the wound.

Well-defined *mucous polyps* of the endometrium are less common than those from the cervical mucosa. Their formation, symptomatology, and treatment are the same. It is an easy matter to miss them during an exploratory curetage of the uterine canal, and for that reason it is always advisable in this operation to search the canal with placenta forceps.

## CANCER OF THE CERVIX

Cancer starting in the cervix of the uterus must be studiously differentiated from that which originates in the body. The two forms are quite distinct, both histologically and clinically, a fact which serves still further to emphasize

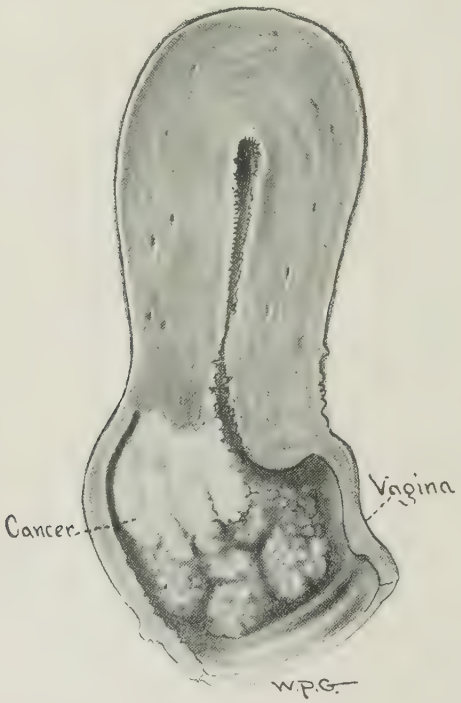


FIG. 113.—EVERTING CANCER OF THE CERVIX.

In this case the disease has originated in the posterior lip of the portio and is growing in cauliflower-like masses toward the vagina. There is only moderate invasion of the cervical wall. It can readily be seen that this form is less treacherous than the inverting type.

that the cervix and body of the uterus are to be regarded as two independent organs that differ widely from each other in their pathologic and physiologic processes.

**Pathology.**—Cancer of the cervix when it comes under observation usually appears as a squamous-cell carcinoma. In its incipiency, however, the growth presents certain differences, according to the particular part of the cervix in which the disease has its origin. It is necessary to remember that the epi-

Fig. 114.—Precancerous Cervix (Adenocarcinoma).

At the top on the right can be seen squamous epithelium ending at a raw surface which, lower down, consists of granulation tissue. The glands in the upper part of the drawing are normal in number; some of them are dilated; but all are lined with columnar epithelium having the nuclei at the bases of the cells. Near the middle is an area of glands showing an increase in number and lying close together. The epithelial cells are lower and the nuclei almost fill them. These cells are still in a single layer and show no tendency to break through the basement membrane. This area shows an atypical arrangement of cervical glands lined by the type of cell seen in early adenocarcinoma of the cervix and is a sign of activity which may be called precancerous.

thelium of the cervix is divided into two parts, that which covers the vaginal portion and that which extends from the external to the internal os, the so-called endocervix. The epithelium covering the vaginal portion is really modified epidermis, and consists of layers of squamous cells like those of the skin, but without hair-follicles, sebaceous or sweat-glands. The squamous epithelial cells just above the external os merge into true mucous cells, which line the surface both of the endocervix and the arborescent glands that branch from the endocervix. In a nulliparous woman under normal conditions the endocervix is entirely concealed and well protected by the contour of the vaginal portion.

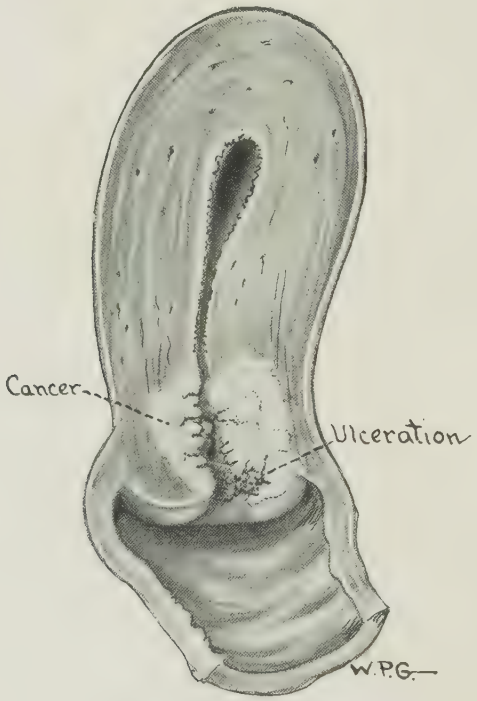


FIG. 115.—INVERTING CANCER OF THE CERVIX.

In this case the growth is invading the walls of the cervix with little tendency to extend outward into the vagina. In this type there is an earlier invasion of the parametrium. It can be seen from the drawing that the disease might escape detection by the examining finger. This form of the disease is especially treacherous.

When the cervix has been lacerated the endocervix tends to evert, and appears redder and more roughened than the squamous epithelium of the vaginal portion. This appearance has led to its being called an erosion or ulceration. Although true erosion may occur, the condition usually is one of eversion or ectropion.

Cervical cancer may originate in the squamous epithelium of the vaginal portion, or in the transition epithelium of the everted area, or in the fully developed cylinder mucous epithelium higher up in the endocervix. If the cancer starts from the epithelium of the vaginal portion it begins as a typical

squamous-cell carcinoma or epithelioma with large polyhedral cells and formation of cancroid pearls. If the cancerous process starts in the everted mucous

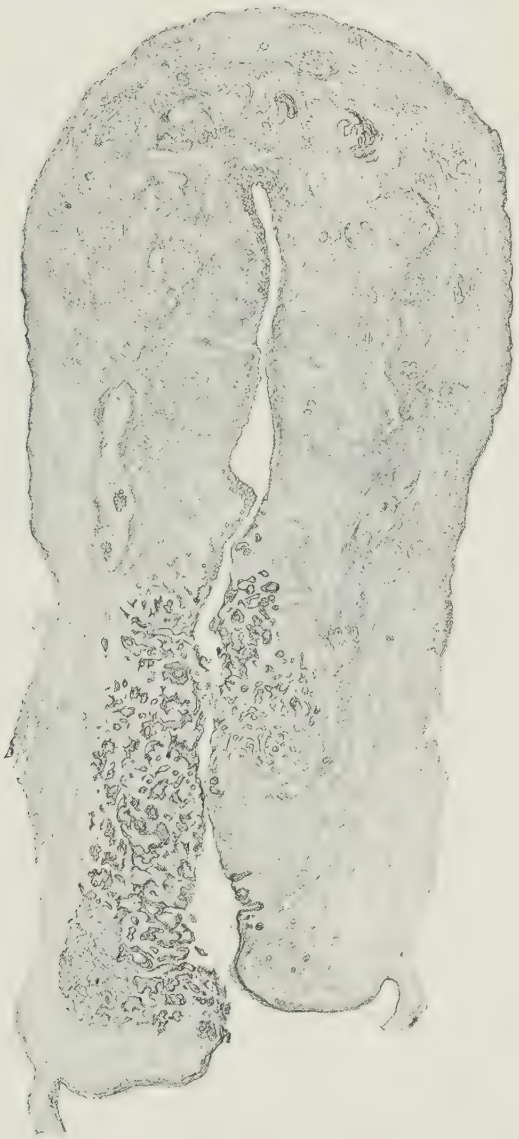

FIG. 116.—ADENOCARCINOMA OF THE CERVIX.

Very low power. Section of the whole uterus. At the bottom on each side is the vaginal wall. The outside of the cervix appears normal. On the left, extending the whole length of the cervical canal, is the growth, invading the stroma of the cervix. More of it can be seen at the internal os on the right. This illustrates especially the importance of curetage for diagnosis, as this growth could not be seen on inspection of the cervix.

membrane or in the endocervical canal, the structure of the epithelial growth is at first adenoid, but this characteristic is usually soon lost and the cells grow

in solid masses, approaching the squamous cell type. As most cases of cancer of the cervix are well advanced before they come to examination, it is usually difficult to tell from the microscopic appearance where the disease started. For this reason nearly all cancers of the cervix are diagnosed as squamous cell carcinomata or epitheliomata.

Occasionally, but not often, the adenoid type persists in a growth originating from the endocervix and the growth remains as a true adenocarcinoma.

It is important to bear in mind the points from which cervical cancer may start, as the course of the disease varies somewhat according to the place of origin. Thus, cancer beginning in the epithelium of the vaginal portion grows outward in papillary excrescences until a characteristic cauliflower mass is formed.

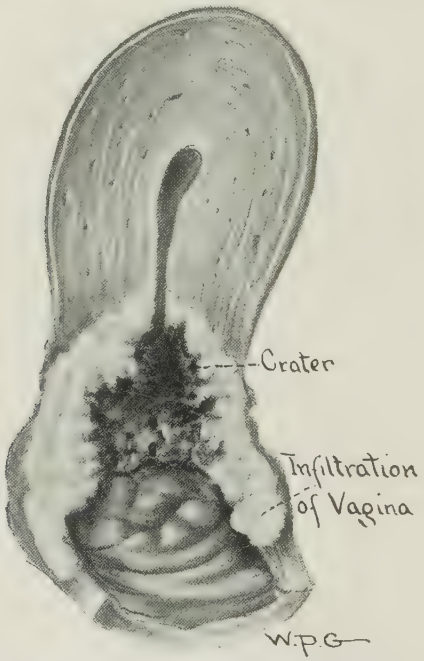


FIG. 117.—ADVANCED CANCER OF THE CERVIX.
In this case the disease has invaded the whole of the cervical walls and is extending into the walls of the vagina and bladder. The crater represents the condition after curetment and cauterization.

It has little tendency to extend toward the body of the uterus, and invades the parametrium and regional lymph-glands relatively later than does cancer of the endocervix. On the other hand, it has a greater tendency to invade the vaginal wall and extend to the bladder.

Cancer of the endocervix may grow outward in a papillary form like that from the portio, especially if it originates in the everted mucous membrane of a lacerated cervix. It has, however, a special tendency to become what is called "invertent"; that is to say, it grows inward toward the cervical wall and parametrium. The process may continue for a considerable time without giving

external evidence of its presence. It reaches the parametrium earlier than does cancer of the portio, and has a relatively greater tendency to metastasize to the regional lymph-glands. It may also invade the vaginal wall by extension in the subepithelial connective tissue, causing a thickening and induration of the wall without disturbing the epithelial covering.

It will be seen, therefore, that this form of cervical cancer is especially treacherous, in that it may progress to an advanced stage without giving warning of its presence.

In the majority of cases the disease has so far advanced before the patient appears for examination that it is impossible to tell, either from gross inspection

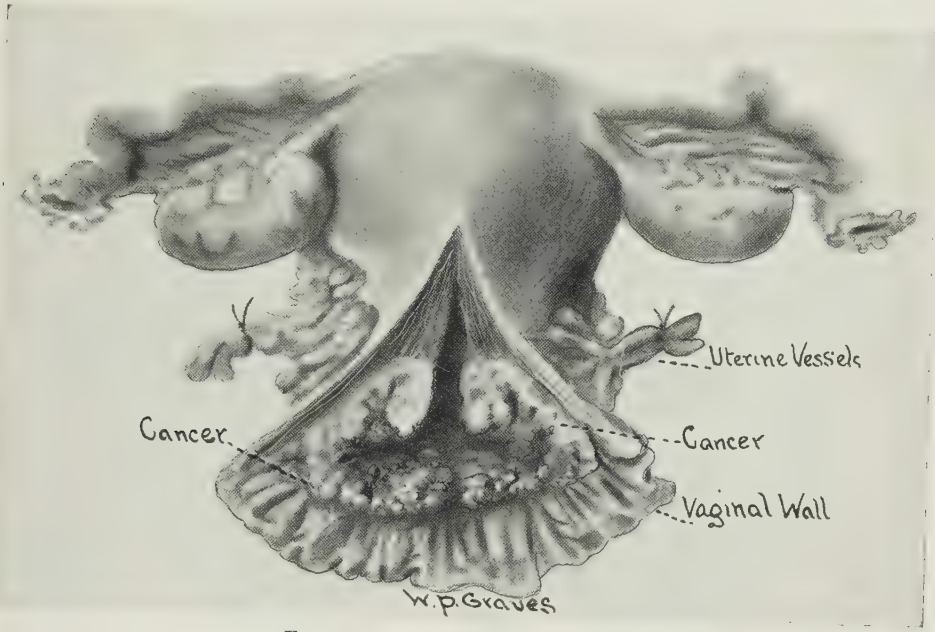


FIG. 118.—CANCER OF THE CERVIX.

The drawing is from a specimen removed by the Wertheim extended method.[1] The uterus has been partly opened to show the extent of the disease. On the sides can be seen the parametrial tissue and uterine vessels. The margin of vaginal wall that must be removed is also shown.

or microscopic examination, the location in the cervix from which the growth originally started. In the following discussion the various types will not be distinguished, but will be included together under the term "cervical cancer."

**Incidence.**—Cancer of the cervix appears most commonly between the ages of forty and fifty. In a series of 6071 cases collected by one investigator (Koblanck) 33.7 per cent. occurred between thirty and forty, and 24 per cent. between thirty and sixty. Occasionally cases are seen later than sixty and earlier than thirty. In our own experience the youngest case has been twenty-five. Craigin has reported a case of cancer of the cervix in a girl of eighteen.

[1] Operation by Dr. H. T. Hutchins at the Free Hospital for Women.

There is a question if cancer of the uterus is as common in this country as in Europe. The statistics of the Continental operators are so enormously larger than are those of our surgeons who practice in populous districts that it seems as if the cases must be fewer in number here. This applies not only to the number of operable cases, but to the total number of cases seen. It is reasonably certain that cancer of the uterus is not on the increase in this country, and

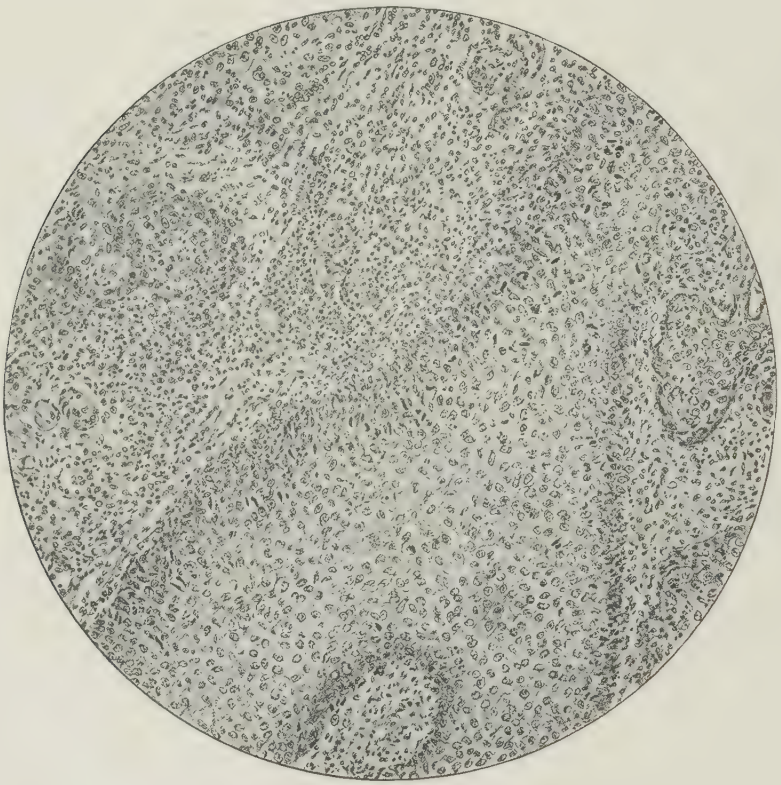

Fig. 119.—Squamous-cell Carcinoma of Cervix.

High power. Most of the tissue consists of large epithelial cells which vary greatly in size, and are infiltrated with a few round cells. A few strands of stroma are seen thickly infiltrated with round cells. Between these two tissues there is no basement-membrane, and the typical basal layer of cells found in stratified squamous epithelium is missing.

more recent statistics show that there is no definite increase of the disease in Europe.

**Etiology.**—Cancer of the cervix is distinguished among other malignant neoplasms of the body by having a very constant and definite etiologic factor in its histogenesis in that it occurs almost exclusively in cervices that have had some inflammatory or traumatic lesion, usually the result of childbirth. It is variously estimated that from 96.5 to 98 per cent. of women with cancer of

the cervix have had children, and that the greater majority have been multiparous.

It has been a common idea that the carcinomatous process is especially favored by the scar-tissue that forms in an old laceration. One theory suggests that after a cervical tear epithelial cells become included in the submucous tissue, and that toward the time of the climacteric, when the stroma begins to lose its power of resistance, the cell inclusion has an opportunity to grow wild. Another theory is that the lesion of the external os deprives the cervical mucous

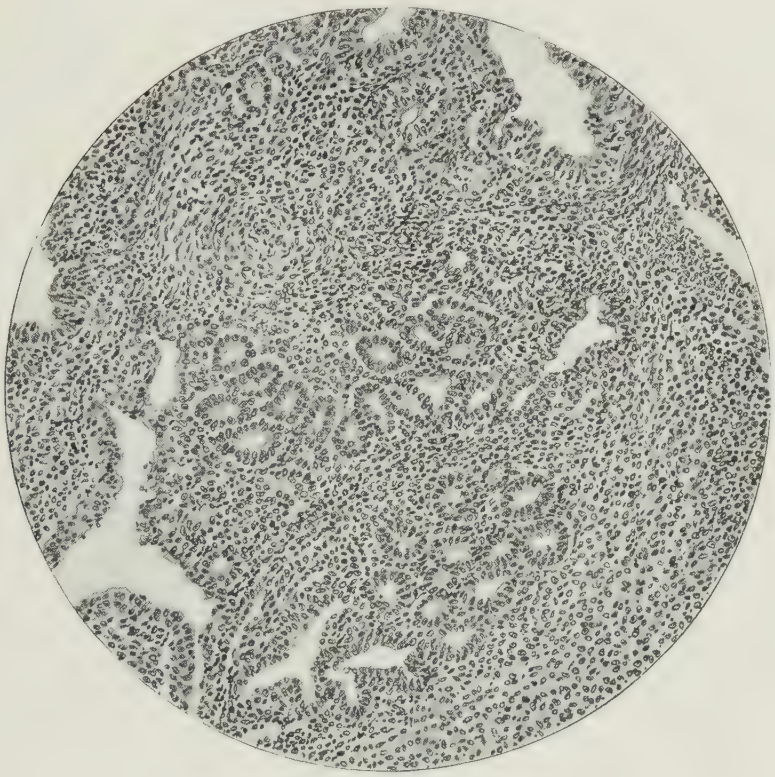

FIG. 120.—ADENOCARCINOMA OF BODY OF UTERUS.
Glands invading the myometrium.

membrane of an important means of protection. Not only is the delicate membrane exposed directly to continual injury, but the mucus, which in the intact cervix acts as a kind of protective plug, now pours directly into the vagina.

Whatever theory is right, there is no doubt that cervices which show an ectropion of the cervical mucous membrane, or an erosion on the external lips, have a special predisposition to cancer. The most common cause for ectropion and erosion is laceration of the cervix. We do find, however, erosions in nullip-

arous women, sometimes in virgin women, where the cause is doubtful. Doubtless the few cases of cancer that occur in nulliparous women originate in erosions of this kind.

An argument that is sometimes advanced against the traumatic theory of the etiology of cervical cancer is the fact that in procidentia, where there is the greatest amount of continuous trauma, cancer is extremely rare. The answer suggested to this objection is that the epidermis in procidentia becomes so greatly thickened and hypertrophied as to act as an efficient protection.

Theilhaber, in his investigations in Munich, claims to have discovered a social element in the origin of uterine tumors. Thus he finds that cancer of the cervix is more common among the poor and ill-nourished, while cancer of the uterine body is more frequently found in the well-to-do. When cervical cancer does appear in the latter class it comes relatively later in life than among the poor.

Uterine myomata he finds much more frequent among the wealthy. He explains this fact as follows: "The frequency of uterine cancer in the poorer classes is not dependent on the greater number of confinements in this section of population, but upon the fact that the better situated women menstruate on an average five years longer than the poorer women. In the congested uterus, myomata develop more frequently, whereas cancers develop in the poorly nourished organ."

**Symptoms.**—Cancer of the cervix is very treacherous, in that it does not cause definite symptoms in the early stages, and because the first symptoms, when they do occur, are not apt to rouse the suspicions of the patient or of her physician. The three cardinal symptoms of cancer of the cervix are leukorrhea, bleeding, and pain, occurring in the order named. The vaginal discharge is due at first to an increase in the normal secretion resulting from hyperemia, and also to a secretion from the newly developed cells. At first, therefore, the vaginal discharge of cancer differs from the normal secretion only in quantity and not in quality. Gradually, however, when the walls of the blood-vessels, changed by the tumor growth, become more permeable, the secretion becomes mixed with blood plasm, and hence assumes a much more watery character. This watery consistency of the vaginal discharge is quite characteristic of cancer of the cervix, and is one of the clinical signs that should arouse suspicion and urge immediate examination of the patient. Later, when necrosis of the tumor mass takes place, with a destruction of the superficial cells and consequent infection by various organisms of decomposition, the discharge becomes exceedingly foul and of a characteristic nauseating odor.

Bleeding is due partly to an erosion of the capillary blood-vessels by the action of the tumor cells, and partly to trauma, by which the delicate papillary outgrowths are broken off during movements of the body, cohabitation, or digital examination. Thus, it will be seen that the cauliflower type of cancer growing from the vaginal portion of the cervix would bleed more readily than the infiltrating form developing from the endocervix, in which trauma would play a less important part. The cauliflower type is less treacherous than the other, as it

gives earlier warning of its presence by bleeding. Bleeding from cancer of the cervix is nearly always venous. Fatal hemorrhages are, therefore, rare.

The ready bleeding of cancer of the cervix from coitus or digital examination is a most important sign, and does not often exist to the same degree in any other condition.

The third cardinal symptom, pain, is one that is of little value in making an early diagnosis, as it does not appear usually until the case has reached an inoperable stage. This is due to the fact that the cervix is a peculiarly insensitive organ, so that while the disease is confined to the cervix itself the patient experiences no pain whatever. When, however, the cancerous process has invaded the parametrium, or has metastasized to the regional lymph-glands, pain ensues, and as the disease advances it may become most excruciating. Unilateral pain in the lower back, near the ischiadic region, is quite characteristic, and it is often seen in recurrent cases following operation before the recurrence can be discovered by objective signs. Although the presence of pain usually signifies an inoperable case, there are exceptions to the rule.

A cancer situated on the anterior lip of the cervix tends to grow toward the vagina and to invade by extension the bladder wall, giving symptoms of cystitis. In many cases this is a late symptom, but the invasion may occur while the case is still operable. It is a serious complication, however, and in general makes the prognosis as to recurrence particularly bad. The invasion of the bladder often causes a fistulous opening in the later stages. Implication of the ureters by extension into the parametrium may cause symptoms of hydro-ureter and hydronephrosis, due to mechanical obstruction of the ureters. Wertheim has shown that the ureteral wall is peculiarly resistant to the invasion of cancerous disease, so that the symptoms are due to external pressure from the surrounding new growth masses. Implication of the rectum is rare and occurs only in the most advanced stages.

It sometimes happens that infection from the cancerous growth extends to the parametrium and pelvic peritoneum. This is especially true of the infiltrating endocervical cancer that forms in the posterior lip and eats its way into the stroma of the cervix toward the posterior culdesac.

In very advanced stages the external genitals may become greatly swollen on account of thrombosis of the pelvic veins. General metastases to distant parts of the body are surprisingly rare, and often do not occur even in the last stages.

The general constitutional symptoms of advanced cancer of the cervix are especially marked by continued fever and by extreme cachexia.

The elevation of temperature is variously explained. It is probable that the differences in the type of fever which various cases show bespeak differences in the cause. High, continuous, and remitting fever, characteristic of sepsis and pyemia, is to be referred to the activity of the bacteria, which, it is well known, infect the cancerous mass. Sapremic fever with a lower pulse-rate than

that of the septic type is due to the absorption of decomposing cancer tissue, while irregular elevations of temperature are caused by the destruction and absorption of protein material, as in necrotic fibroids and disintegrating hematoceles (Koblanck). Patients with advanced cancer of the cervix show marked improvement after palliative operations of cureting and cauterizing the excrescent masses, the improvement being largely due to a diminution in the amount of toxic absorption. Temperature elevation does not ordinarily appear in the primary stages, so that it is of no great value in making an early diagnosis.

The cachexia that results from cancer of the cervix is extreme, being rarely equalled in any other form of cancer in the body, and is a fit setting for this gruesome disease. It is accompanied with great emaciation, but neither cachexia nor loss of weight is apparent during the early stages. The causes which contribute to this cachexia are lessened nutrition from loss of appetite and hemolytic changes in the blood, due to absorption of toxic products from bacterial processes or from protein destruction.

**Prognosis.**—The duration of the disease from the time of the first appearance of symptoms varies from one to three years. Much depends on the care which the patient receives. With occasional palliative operations to remove the sloughing masses and with constant cleansing of the discharges life may be prolonged for a surprising period of time with comparative comfort. Most of these patients die from wasting and exhaustion, distant metastases and intercurrent diseases not being common in patients under careful treatment. The last days of neglected cases are shorter than those of patients under systematic care.

Although cancer of the cervix is one of the most murderous of malignant diseases, the prospects of surgical cure are exceptionally good if an early diagnosis can be made, on account of the slight tendency to metastases. Early diagnoses are prevented partly by the treacherous onset of the disease and partly by the indifference of patients to warning symptoms, and the neglect of physicians to make thorough vaginal examinations. In Germany, where systematic education of the laity is successfully carried out, patients come sooner for treatment, and hence the percentage of operable cases is larger than it is in this country.

The **diagnosis** of cancer of the cervix is comparatively easy. The large cauliflower masses of cancer of the portio are very characteristic, and can be confounded with nothing except a sloughing myomatous or mucous polyp. In the latter case the pedicle can be made out either by palpation or inspection.

In the ulcerative form the diagnosis is somewhat more difficult. There is usually a suspicious hardness and irregularity of the cervix that calls attention to the condition. Friability of the tissue with bleeding is the most important sign, and one that is practically always present. Tubercular and syphilitic ulcers are very uncommon, but may simulate cancer, the diagnosis being readily made by the microscope. Decubitus ulcers made by ill-fitting pessaries, or such as are seen in procidentia cases, are often mistaken for cancer. The

ulceration caused by pessaries heals up in a short time under treatment, and can thus be distinguished from cancer. In procidentia the decubitus ulcers have a characteristic flat, dry appearance, with little tendency to bleed, and with a sharply defined margin of scar tissue. One must remember, too, that in procidentia cancer of the cervix is extraordinarily rare. Nevertheless, a microscopic examination should be made on the least suspicion.

Ordinary erosions of the cervix often simulate cancer closely. The general cervicitis, with Nabothian cyst formation that is frequently associated with erosion, may be very suggestive of an infiltrating cancer of the cervix, while it occasionally happens that an erosion may bleed on digital examination or after coitus as freely as would an early cancerous growth. The finding of Nabothian cysts in cervicitis cases is usually evidence that the condition is not cancer. According to Schröder, the presence of these cysts absolutely rules out cancer. This, however, is an error, for we have found instances in which an early cancer existed side by side with extensive Nabothian cysts and general cervicitis. Frommel has reported two such cases and Koblanck has reported one. It is probable that if cancers of the cervix were oftener observed at an early stage the combination with cystic cervicitis would be found to be not infrequent.

The infiltrating form of cancer starting from the endocervical portion may often be very difficult of diagnosis, especially in cervices that have undergone senile atrophy. There may be no apparent enlargement of the cervix, and its outward appearance, as observed through the speculum, may be perfectly normal. A watery discharge or bleeding are the warning signals. The condition usually confounded with this type of cancer is senile vaginitis, senile cervicitis, or pyometra. In the latter class of cases there may be bleeding from eroded areas of the vaginal wall, and the discharge, especially if partially obstructed by plastic adhesions of the cervix or vagina, may become excessively foul and have an odor very like that of cancer. The discharge, however, is usually thick and creamy, containing as it does great quantities of desquamated epithelium, as distinguished from the thin watery discharge of cancer. If blood is present a careful examination must be made in the Sims position, to determine whether it comes from the uterus or from a superficial erosion of the vagina. If the blood is from the uterus, the probabilities are very much in favor of cancer and an immediate intra-uterine examination is urgent.

Every single case, either of suspected or of perfectly obvious cancer, should have a specimen removed for microscopic examination. Even if the case is, beyond question, one of cancer a microscopic examination of a section from the growth should be made merely as a matter of record, for no report of a cancer case is complete or authentic without this evidence.

From the standpoint of diagnosis the microscope is of supreme importance. The surgical errors of omission and commission in cancer of the uterus are almost invariably due to a neglect of this routine principle.

Unfortunately, the removal of a specimen from the cervix is a matter of some

technical difficulty, and it is doubtless for that reason that this all-important step in the diagnosis is so frequently omitted by the general practitioner. The procedure may be done in the Sims position with the aid of a Sims speculum. The light must be good, and at least one assistant is needed. It is necessary to use long vaginal scissors and forceps or some special instrument, of which there are several types on the market. In removing a specimen from an ulcerated area when the tissue is friable and bleeding this small operation may become quite difficult. Only a small bit of tissue is necessary, and it should be put at once into 5 per cent. formalin solution and sent to a pathologist for frozen section and examination. For the infiltrating form of cancer of the cervix a specimen can best be removed by a small curet. No anesthesia of any kind is necessary. The bleeding that is caused is not dangerous and is easily controlled by tampons.

**Operability.**—When the diagnosis of cancer of the cervix is confirmed, the next step is to determine the operability of the case. This depends on the amount of extension which the disease has undergone beyond the uterus. As the cancerous process invades the parametrium or infiltrates the wall of the vagina, the uterus gradually becomes fixed, so that the extension of the disease is determined chiefly by the mobility of the uterus. This sign is, however, a deceptive one, for it may be influenced by other factors. Thus, a large cauliflower mass, extending from the portio into the vagina, may cause the impression of general immobility, whereas, after cureting the mass away, the uterus may be found to be comparatively free and movable, with little extension of the disease into the parametrium. Not infrequently the parametrial infiltration is entirely inflammatory in character. It is impossible to distinguish this condition from cancer by digital examination, and it is not always possible to tell the difference even after the abdomen is opened. It should be noted, therefore, that many cases are entirely operable which on first examination seemed hopeless. It is also important to remember that the operability oftentimes can be determined only by an exploratory laparotomy, and there should never be any hesitancy in performing one if there is the slightest hope of finding the case operable.

The presence of cancerous infection of the regional lymph-glands is regarded by some as a contra-indication to radical operation on the ground that recurrence is sure to follow. The presence of infected lymph-glands unquestionably makes the prognosis unfavorable, but by no means hopeless, as Wertheim and others have shown permanent cures in such cases after extirpation of the glands. The presence of enlarged glands in a case of cancer of the cervix does not necessarily mean that they are cancerous, for a considerable percentage of them are inflammatory and show no microscopic evidence of cancer. When the disease has metastasized to the regional lymph-glands the case is more favorable if only a single gland is infected, even though extensively, than when there is multiple involvement.

Involvement of the bladder wall and of the tissue surrounding the ureters does not necessarily contra-indicate operation, for portions of the bladder may be resected successfully and the ureters may be freed from extensive growths, or resected and transplanted into the bladder, without later recurrence of the disease.

The question of operability depends to a considerable extent on the method of operation employed. The development of the extended abdominal operation for cancer of the cervix has greatly increased the percentage of operable cases. Whereas formerly the number of cases considered suitable for operation averaged about 10 to 15 per cent. of all those seen, now the percentage of cases operated on averages 50 per cent. Wertheim's figure is 61 per cent., while Bumm claims 90 per cent. In this country, where the laity and the profession are poorly educated in the subject of cancer of the cervix, there are only a few localities where the operability percentage would be as high as 50 per cent., and in most places the proportion falls far below that.

**Operative Treatment.**—There are at the present time two principal methods of operating on cancer of the cervix, namely, total extirpation of the uterus, either by the vaginal or the abdominal route. Schauta is the chief exponent of the vaginal operation, while Wertheim is the most famous advocate of the latter method.

Abdominal extirpation of the uterus for cancer of the cervix was first performed by W. A. Freund in 1878, who, after a series of experiments on the cadaver, operated successfully on a case and published the technic of his operation. Freund's operation is the one used at the present day, and to him must be given the credit of originality, while to Wertheim belongs the distinction of popularizing the operation and making it of great clinical value. The technic of the procedure with Wertheim's individual modifications is described on page 779.

There seems to be little doubt that the extended abdominal route for cancer of the cervix is, in general, preferable to the vaginal, the chief advantage of the operation being that more room is secured for wide dissection of the parametrial tissue, so that it is possible by this method to operate on much more advanced cases than is possible by vagina.

Figures showing the number of final cures after the five-year limit are in favor of the abdominal route, when it is taken into consideration that much more advanced cases are operated on in this way. The mortality percentage is somewhat lower in the statistics of the vaginal method than in those of the abdominal, but here again one must take into account that the cases performed by the latter method are, on the average, considerably more serious.

The following figures represent the average results from the leading clinics in which the abdominal operation is performed:

*Operability:* 50 per cent. of all cases that present themselves for treatment.

*Primary Mortality:* 5 to 11 per cent., the most common causes of death being peritonitis and shock from hemorrhage.

*Cures:* 30 per cent. after the end of five years.

### Other Methods of Treating Cancer of the Cervix

**Radiation Treatment of Cancer.**—In the present status of our knowledge and experience in the use of radiation for the treatment of malignant disease no didactic statements should be made. We can only summarize what has been accomplished to date, and speculate from these data as to possibilities of future success in this promising field of therapy.

It may be said, in general, that as a palliative for certain forms of cancer radiation has proved itself, beyond all question, to be of inestimable value. As a measure for the complete and permanent cure of cancer there is now sufficient evidence to show that in many cases it has been entirely successful. With the rapidly increasing knowledge of the subject and improved methods of application, the outlook for the method of treating malignant disease is extremely promising.

Up to the present time radiation has had its best success in various forms of epitheliomata, on account, no doubt, of the easier access to this type of cancer, most brilliant results having been attained in the treatment of epitheliomata of the uterine cervix. For this reason the subject is one of especial interest to the gynecologist.

Radiation in the treatment of cancer is at present being given chiefly by the *x*-ray, in the form of mesothorium, in the form of radium, or in the form of radium emanations. As a rule, the Roentgen rays are used only as an aid to radium. It may be said, however, that improvements are being made in the technic of *x*-ray therapeutics, and that this form of treatment is becoming more and more important.

The radio-active substances, radium and mesothorium, according to present theories, exercise their influence on the tissues by means of three kinds of rays, termed alpha, beta, and gamma rays, which differ from each other in velocity, penetrability, effect on the tissues, etc. Of these three, the gamma rays and the hard beta rays are of pre-eminent use in the treatment of cancer, for, in addition to their greater penetrating power, they have a selective action in destroying the cancer cells without injuring the cells of the surrounding normal tissues.

Burnam describes the physical properties of radium thus:

"Radium is a metallic element belonging to the strontium barium group. It readily forms salts with the mineral acids and is the leading member of the peculiar radio-active group of elements which are characterized by atomic instability. Radium itself is formed by atomic reduction from uranium. It loses a portion of its atom to become a gas called radium emanation, and this, in turn, is the mother, grandmother, etc., of a series of solid elements. The so-called radium C, third in series from the emanation, is that member of the group which particularly concerns us, as it is from it that both the beta and gamma rays are derived. Radium emanation can be separated from radium as fast as it is formed. A given amount of radium is

capable of producing a given amount of emanation. The emanation reaches a maximum and then disintegrates at the same rate that it is being formed. In about four days a given amount is reduced to one-half. If radium or radium emanation is sealed in a glass or a metal container it begins to produce radium C. The maximum amount of radium C is obtained in a radium preparation so placed in a glass tube in thirty days. The maximum amount from emanation is produced in three hours and thirty minutes. Radium C itself can be isolated, but has such a short life, only two or three hours total, that it cannot be effectually used in practical treatment.

"The essential characteristic of the radio-active substances is the giving off of invisible rays. These rays must not be confused with the emanation, which is an element just as radium itself is. The rays have been divided according to their physical characteristics into three kinds: the alpha, the beta, and the gamma.

"The alpha ray is a positively charged atom of helium. It has a very small power of penetration, being completely stopped by a thin sheet of writing paper. It acts very powerfully toward inducing chemical change in both inorganic and organic matter brought in contact with it. The beta ray is a negatively charged electric ion which has about the velocity of light and will easily penetrate several centimeters of living tissue. It has also a marked capacity for inducing chemical changes in organic matter subjected to it. The gamma ray is not particulate matter, but a vibration of ether similar to ordinary light and of the *x*-ray. It differs from them in being of much shorter wave length and of much greater penetration. It has power also, but to a lesser degree than the alpha and beta rays, to produce chemical change in organic matter exposed to it. When a radium salt is enclosed in a glass tube, alpha, beta, and gamma rays are produced within the container. The alpha rays are held in the tube, while the beta and gamma rays penetrate its walls, and pass out into the surrounding medium in radial lines, thus making a sphere of radiation. When the glass tube is further surrounded by 2 mm. of lead, the hardest beta rays can no longer penetrate this envelope. It is possible, therefore, in medical treatments to use all three kinds of rays together, the beta and gamma rays together, or the gamma rays alone. It is impossible to use the alpha rays alone, and it is difficult to use the beta rays alone in anything except experimental work.

"From the above it is evident that radium or one of its derivatives can be used in two essentially different ways: first, it can be taken into the body by mouth, hypodermically or intravenously as any other soluble drug; second, it can be applied from either outside or inside the body in sealed tubes or other containers in the same general way that an *x*-ray tube is employed."

Destruction of the cells acted on by the gamma rays is shown by swelling and vacuolization of the protoplasm and shrinking of the nuclei, followed by phagocytosis and absorption. The space occupied by the destroyed cells is replaced by a homogeneous connective-tissue meshwork.

Local changes of a gross nature depend to a considerable extent on the character of the growth. In advanced cases, especially if the cancer is of the inverting type, the effects of radium may be comparatively slight. It is our opinion that the histologic structure of the disease has an important bearing on its reaction to radium influence, for it has been our observation that the cervical cancers of the adenomatous type are less susceptible to successful treatment than are those of the squamous-cell variety. This is quite true of cancers in other parts of the body and may be due to some inherent reactive property in the cancer cell itself or to the fact that epitheliomatous cancers are usually more accessible for the direct application of radium. In cervical cancer the glandular types originate from the endocervical epithelium and have a special tendency to extend inward toward the parametrium. It is more difficult, therefore, to reach them with radiation. The purely squamous epitheliomata originate from epithelium of the

vaginal portion of the cervix and tend to grow outward into the vagina. In cancers of this kind radium produces astonishing results. Even large cauliflower growths filling the vagina may, in three or four weeks, with no other treatment than a few applications of radium, be made to vanish without bleeding or discharge.

The condition of the cervix and vaginal vault after a successful course of radium treatment is characteristic. In place of the cancer mass there is left a thick yellowish membrane densely adherent which may persist for several months. The cervix and vaginal vault undergo a peculiar shrinkage which simulates somewhat the changes of senile atrophy. The vagina, which normally is broad and roomy at the vault, narrows down into the form of a cone. At the apex is the cervix, which has completely lost its conformation and exists now only as a dimple. Investing the upper vagina is seen the yellow adherent exudate mentioned above. To the examining finger the tissues present an entirely characteristic feeling of fibrous density. The parametria are often rigid, while definite thickenings are sometimes felt in the paravaginal tissue, especially in the rectovaginal septum. In cases in which the paravaginal reaction is severe there are usually symptoms of vesical or rectal tenesmus according to the organ toward which the infiltrating process extends. The mucous membrane of the bladder or rectum may be affected, with resulting cystitis or mucous colitis.

Involvement of the paravaginal tissue affecting the adjacent organs is usually the outcome of insufficient screening and not infrequently results in fistulæ which may not appear until long after the application of the radium. An operation performed during the stage of infiltration encounters great technical difficulties. The cellular tissue is vague and confused and the normal planes of cleavage are obliterated. The bleeding is free and difficult to control.

It seems probable that the thickening of the parametrial and paravaginal cellular tissue represents a form of inflammatory reaction, for in the course of three or four weeks it gradually diminishes and the tissues assume a somewhat more pliable consistency. It is noteworthy that if there exists a pelvic inflammatory process at the time of the radium application, the condition may be lighted up into an acute stage; while a radical operation performed during the reaction stage is very apt to be followed by serious sepsis. These two facts seem to support the theory that the reaction is of an inflammatory nature.

In the course of six or seven weeks the parametria again become tight and rigid. This is due to a scar-like shrinkage, an unyielding sclerosis, of the cellular tissue. If an operation is undertaken at this time serious difficulties are also met with. The planes of cleavage are permanently obliterated, so that the separation of bladder from cervix and vagina and the isolation of the ureters can be done only by dangerous, painstaking dissection.

According to Frank, the shrinkage process of the parametrial cellular tissue plays a part in the temporary curative effect produced by radium. From his histologic studies he finds that after a maximum exposure the radium manifests

a direct action on the cancer cells for only a distance of 1.5 cm., but that the curative effect may be seen throughout a much wider area. In order to account for this he believes that some other local factor must come into play. To quote

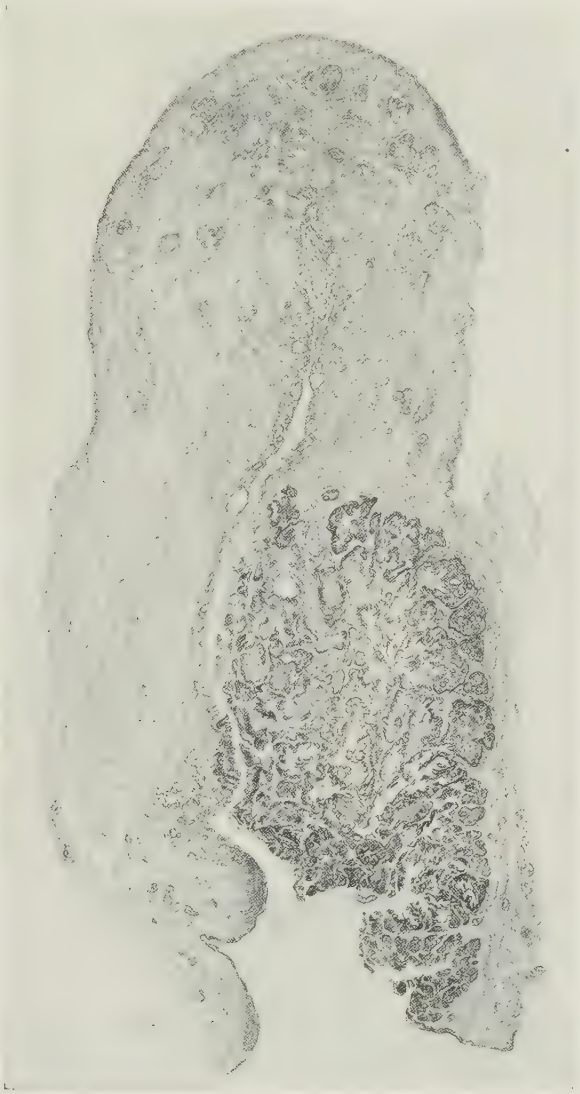

FIG. 121.—SECTION OF CERVICAL CANCER REMOVED BY A WERTHEIM OPERATION AFTER TREATMENT WITH RADIUM.

Radium had evidently been inserted in the cervical canal. The cancer cells near the cervical canal and in the interior of the cancer mass have been destroyed. The darker portions around the periphery of the mass show the presence of active cancer cells. This is a drawing from a section made at Wertheim's clinic, and lent to the author by Dr. T. A. Ordway.

Frank: "This local factor, in the case of cervical carcinoma, is probably supplied by the large quantity of connective tissue (parametria) which radiates from the cervix in all directions. Under the influence of the rays the connective tissue

contracts, hardens, and perhaps proliferates. As a result, the lymphatics and smaller blood-vessels are permanently blocked, and the dense scar produces a condition of "starvation" of the growth, a condition which has, at times, been obtained by surgical means (ligation of the internal iliac arteries).

The selective action of the gamma rays on cancerous tissue is most marked if the radium is placed either in contact with or within the tumor mass. If normal tissues intervene the dosage must be much greater and the effect is less favorable.

Harm may be done either by an overdosage or an underdosage. If the dose of radium is too powerful, there may result an excessive destruction and absorption of the tissues. If the dose is insufficient, it may result in stimulating the growth to fresh activity.

Harris summarizes the therapeutic value of radium by stating that its efficacy depends: (1) Upon the amount used; (2) the amount and nature of filtration; (3) the distance from the tumor tissue; (4) the length of exposure; (5) the resistance of the tissue, and (6) the number and length of exposures, as determined by the clinical judgment of the user.

In a favorable case the local effect of radium on cancer of the cervix is very remarkable. The fetid discharge and odor ceases, bleeding stops, and the tumor masses and nodules rapidly melt away and disappear. In some cases, which before treatment seemed hopelessly inoperable, no sign of cancer can be detected by bimanual examination. Pain is often relieved immediately and completely.

Favorable results of radium treatment are also seen in the early treatment of recurrences following radical operation, especially when the recurrence takes place in the scar at the vault of the vagina.

Unfortunately, all cancer cases of the cervix do not react in the satisfactory manner that we have described above. In certain far-advanced stages radium may stimulate the growth to renewed activity of a most alarming nature, death being hastened by many months. This is in line with the observation of Seuffert that the younger the cell, whether cancerous or normal, the more sensitive it is to the action of radium. In the presence of pelvic infection, such as may exist from extension from the cancer through the parametrium, or such as may result from a previous tubal inflammation, the application of radium is apt to set up an active pelvic peritonitis.

If the cancer has involved the bladder or rectal wall, radium treatment is apt to result in large fistulas, a possibility which in the advanced cases often contra-indicates the treatment.

It has been the author's experience that there is greatly increased danger of postoperative sepsis if a radical operation is performed too soon after a radium treatment. This was shown in three successive cases in which the operation was performed within a few days of the last treatment. Other operators, notably Wertheim, have made the same observation. The cause of this is a matter

of speculation. It would seem either that the sepsis is the result of the presence in the tissues of latent organisms that are stirred up to new activity by the influence of the rays, or that the rays devitalize the normal tissues and produce in them a temporary lack of resistance to infective organisms.

In most cases there is very little systemic reaction after the use of radium, but some patients complain of headache, loss of appetite, pain in the intestines and bladder, constipation, and diarrhea. Rectal tenesmus, or strangury, or both are distressing symptoms that sometimes complicate the convalescence. They indicate usually an insufficient protection of the rectum or bladder. Symptoms of this nature if severe and prolonged are often followed later by fistulæ. There is sometimes a rise of temperature, probably due to the stirring up of some local inflammatory process or the absorption of the necrotic cell material. Elderly people and those in a much depleted physical condition may be made very sick. In one of our cases an acute nephritis with alarming symptoms followed the first radium treatment, though it rapidly subsided.

It has been said that the reason that the best results of radium treatment have been reported by gynecologists is because cancer of the cervix has comparatively little tendency to metastasize, and this is undoubtedly true. If the cancerous process has extended to the regional lymph-glands, radium treatment is of comparatively little value, excepting for its effect on the primary focus. Veit, however, is of the opinion that irradiation of the primary cervical focus may cause a regression of the disease in the lymph-glands. Scheuer thinks that the Roentgen rays have a power of reaching gland metastases and parametrial infiltration better than do the rays of mesothorium and radium.

*Selection of Cases for Radium Treatment.*—In the treatment of a given case of cervical cancer numerous factors requiring experience and careful judgment must be taken into account. Most important of all is the question between radical operation and the employment of radium.

At the time of writing (1923) there is a considerable difference of opinion among surgeons on this subject. We shall therefore present the conclusions that we have made from our personal experience, with the realization that some of the opinions will be at variance with those that we have previously published, and that they may be revised in the light of new experience.

*The Operable Case.*—The discussion of this heading requires first a definition of operability and secondly an argument as to the comparative merits of operation and irradiation. Before radium came into vogue operability depended on the surgeon's individual estimate of his ability to perform a radical operation without running too great a risk of killing the patient on the table. As a consequence the variation in operability percentages was enormous, ranging as it did from 10 per cent. to more than 80 per cent. A few rash operators satisfied with a 25 per cent. mortality, and determined to eradicate the disease at whatever expense of damage to the patient's excretory organs, brought upon the operation an undeserved opprobrium; while the timid surgeon with his 10 per cent. operability created a feeling of hopelessness regarding the disease as a surgical proposition. Since radium has come into use the matter of operability has undergone a very marked change and this may well be illustrated by recounting our personal experience at the Free Hospital. In a report made by the author in 1920, the operability figure was approximately 64 per cent. Since that time, as a

result of an increasing reliance on the aid of radium, the percentage has appreciably dropped. In deciding on the operative treatment of a given case, the question is no longer "Can we perform a radical operation without killing the patient?" but rather, "Have we by performing a radical operation a reasonable chance of *curing* the patient?" We feel that with our considerable experience in operating on all kinds of cases and following the results, we can answer this question with a fair degree of accuracy.

Thus it will be noted that we have practically eliminated the so-called border-line case. The border-line case is not standardized, but implies a doubt in the surgeon's mind as to whether he is physically capable of removing the uterus of the case in question. Speaking from a personal standpoint when such a doubt arises, we usually assign the case for treatment with radium. Whether this decision is an indication of sound common sense, or whether, under a false sense of security, it is in reality an avoidance of the responsibility of performing a very hard operation, ultimate results will tell.

Changing then the term *operability* to the expression *curability by operation*, we will take up the question of treating such cases by radium or operation. We believe that under present conditions operation distinctly offers the greater chances of success than does irradiation for the following reasons:

1. Although cancer of the cervix, as a rule, metastasizes in the regional lymph-glands comparatively late in the disease, nevertheless it not infrequently happens that in cases when the local affection is early and the growth frankly operable, the glands are found involved. This seems to be especially true in young women. Such cases may sometimes be permanently cured by operation. If radium be used the disease localized in the cervix may be cured, but the more distant regional lymph-glands cannot reliably be treated even by the most powerful internal and external irradiation.

2. In curable cases, with the disease definitely localized in the cervix, there is no doubt that surgical removal of the entire organ is a more certain means of eradicating the growth than is irradiation. Everyone who has used radium has been chagrined on occasions to find that he has missed the mark and that only a part of the growth has been successfully stormed by his radium forces. New methods of treatment, especially those by which emanations in seeds are employed, have greatly reduced the chances of this source of failure, nevertheless it is inconceivable that even with the most expert application radiation can be compared in certainty with surgical removal, at least until the time comes when means are discovered by which efficient rays of greater penetration may be produced.

3. In treating a curable case of cervical cancer it must be remembered that patients differ in their individual reaction to radium, a fact that is especially apparent in the treatment of non-malignant myopathies. The proper relationship of the dosage to the individual is an unknown but probably important factor. Moreover, it should be kept in mind that so-called cancer of the cervix represents in its category several different types of carcinoma which possess individual characteristics of growth, and which doubtless react differently to radium. This is an important field of inquiry which has only slightly been explored.

In view of these disturbing factors one need not be surprised at the occasional sinister case in which after a standard application of radium the disease is stimulated to an appallingly rapid growth.

4. A word should be said in defense of the radical operation the evils of which have been greatly exaggerated by certain enthusiasts. To disprove the accusation that the operation is attended with a prodigious mortality and that it is followed by ghastly fistulas and other mutilations one need go no further than the more recent operation reports. The figures show a uniformly low mortality and only rare occurrence of fistulæ, while the percentage of cures is encouraging.

It should be remembered that all these reports include many border-line and desperate cases. If, as we have proposed, such cases be eliminated from the operability standard, the ultimate results of the radical operation for early cervical cancer should not differ appreciably from those of hysterectomy for other causes.

*Preoperative and Postoperative Irradiation.*—Many operators make a preliminary application of radium, some with the purpose of making an inoperable case operable, others using it simply as a routine prophylaxis in frankly operable cases. We have had some experience

in operating on cases made operable by radium and found it very unsatisfactory. The increased difficulty of the operation, the danger of septic complications, and the invariable recurrence of the disease have led us to abandon the practice; and this experience has evidently been shared by many other surgeons.

The practice of applying radium as a routine preoperative measure in frankly operable cases is popular, but it is difficult to understand its value. Irradiation in such cases cannot reach further than the knife, while it has the disadvantage of devitalizing the normal tissues and making them more susceptible to sepsis when the operation is performed. As a preliminary cleansing measure it has no special advantage over a judicious curettement and cauterization.

Postoperative radium prophylaxis is at the present time recommended by the majority of operators. We do not make a routine practice of this measure in every case. If the operation has been a satisfactory one, that is to say, if we feel that we have removed all of the disease, we do not use radium. In such cases the tissues at the vault of the vagina are thin and there is peculiar danger of producing fistulæ from a radium burn. If, however, we are doubtful of having removed the disease (and such a doubt usually implies a certainty) radium is applied as soon as the vaginal wound is healed. In some of these cases radium has undoubtedly prolonged the patient's life and increased her comfort. This comparative success has influenced our judgment during the progress of an operation in cases in which the disease is found to be more extensive than was expected. Thus if the parametrium proves very difficult we are accustomed to abandon the complete Wertheim technic, and to take a short cut on one or both sides close to the cervix, relying on the later radium treatment to take care of possibly diseased parametrial tissue which could not be removed without considerable danger to the patient. After the uterus has been removed this tissue is more accessible for irradiation.

*Operable Cases with Contraindications.*—One encounters a number of cases which, though technically operable, present certain contraindications to operation, chiefly cardiac or renal disease, old age, and obesity. Of these, obesity is the most important on account of its increasing enormously the technical difficulties of the operation. These comparatively early cases we are accustomed to treat by radium alone, and their outcome will be of great value in determining the relative value of irradiation and operation.

*Border-line Cases.*—It is necessary to add a few words to what has already been said concerning border-line cases. These cases are usually incurable by operation or by radium, although by either method a successful result may occasionally be obtained. We have, as we have said above, relegated them to the radium treatment because radiation is less dangerous to the patient's life, and, on the whole, produces equal if not better results in the prolongation and comfort of life. An exploratory incision is always justifiable to determine the exact extent of the disease.

We have been very much impressed recently by a number of cases that have reported after a radium treatment given from a year and a half to two years previously. Many patients of this type enjoy excellent health for a year or two after treatment when they begin to show symptoms of the disease in the regional lymph-glands. Vaginal examination often shows no local evidence whatever of cancer. In some, masses can be felt on the sides by abdominal palpation; in others the presence of the disease is evidenced only by the characteristic pain. It seems reasonable to believe that some of these patients might have been cured or at least had their lives prolonged if at their first appearance the affected glands had been removed before the radium treatment had been applied. With this idea in mind we have recently instituted the policy of exploring the abdomens of inoperable but not hopeless cases, and of removing if possible the infected glands.

*Hopeless Cases.*—We treat with radium practically every inoperable case of cervix no matter how hopeless, unless fistulæ have been establishd; and in most instances we have been able to relieve the patient of bleeding and discharge and frequently of pain. Evil results from radium in these cases, such as have often been described, we also have encountered, but they have usually followed a too enthusiastic application of the radium. In the hopeless as well as in the curable cases it is our experience that whatever benefit the patient is to receive from the radium treatment must be secured *at the first dose*. Secondary treatments rarely if ever

help the patient and frequently stimulate the growth of the disease in an astonishing manner.

*Recurrence.*—Local recurrence in the vagina after radical operation is peculiarly amenable to irradiation. We have in our series evidence to show that the disease may sometimes be thereby ultimately cured. Extension and reappearance of the disease in the glands is in our experience hopeless. Powerful *x*-ray treatment is the only resource.

*Details of Radium Treatment for Cancer of the Cervix.*—The use of radium in the treatment of cervical cancer is still in the experimental stage, hence there are no very definitely standardized rules for its application. Space does not permit of a full description of the methods employed by the most reliable operations, and such a description would present so many variations that it would cause confusion to the beginner who, having secured the control of a certain amount of radium, desires some well-defined basis for his initial treatments. We shall, therefore, present the general rules which we have adopted in our personal work. Only a few institutions and individuals are fortunate enough to have acquired sufficient radium to employ the emanations. In the treatment of large numbers of patients and probably also in the application to individual cases, radium emanations are superior to the radium salts more commonly used. The employment of emanations, however, requires an outfit too expensive for the average hospital, as well as the services of an expert physicist. We shall omit a discussion of this important part of the subject and confine ourselves to describing the direct application of the radium salts which, on account of the recently increased production of radium, have become available for many institutions and individuals.

In securing radium for the treatment of cervical cancer the minimum amount required is 100 mg. The most convenient form in which to purchase the radium is in three tubes, one containing 50 mg. and two containing 25 mg. each. By having the radium in separate tubes not only may the dosage be more easily regulated, but when feasible the tubes may be so distributed in relation to the tissue to be treated that a cross-fire effect may be attained.

In applying radium the question of screening is of very great importance. Radium in the form of radium bromid, as it is usually put out commercially, is tightly packed in small glass cylinders which are, in turn, incased in silver or platinum tubes. The metal tubing acts both to protect the radium from loss and to screen off the soft rays, which, as has been noted above, are injurious to the tissues. More complete screening of the soft rays may be secured by still further encasing the silver tubes in brass or lead. It has been shown that gamma rays emerging from a metal screen set up secondary beta rays which are as destructive to tissues as the primary beta rays. These secondary beta rays, though possessing penetrating power equal to that of the primary radiations, are endowed with much less absolute energy and may be effectively obstructed by such materials as paper, cloth, or rubber. It is customary, therefore, to protect the tissues still further by enclosing the metal receptacle of the radium in gauze and pure rubber (see Part III for technic).

In treating cancer of the cervix the most effective protection of the bladder and rectum is secured by a vigorous packing of the vagina with strips of gauze, by which means the vaginal walls are kept as far away as possible from the radium.

The dosage of a given radium application is usually estimated in terms of milligram hours (mg. hrs.) or millicuries, computed by multiplying the number of milligrams used by the number of hours applied. Thus a dosage of 2000 mg. hrs. may represent the application of 100 mg. for twenty hours or of 50 mg. for forty hours.

Having determined to employ radium in treating a properly selected case of cervical cancer, the operator is met with the important question of dosage. On this subject the profession is very much in the dark, as is evidenced by the wide variation in opinions regarding it. There is very little information as to how to adapt the amount and time of exposure to the individual case. If this phase of the subject were understood we should doubtless have an explanation of why in one case the disease responds magically to treatment, while in an apparently similar case with like treatment the effect is either neutral or even disastrous. Space does not allow a full discussion of this subject. We have intimated above that variations in the histologic structure may account to some extent at least for differences in the results of treatment. Possibly the differences are due to individual tissue resistance to the action of the rays.

In prescribing radium for cervical cancer one must always bear in mind that the substance may be a powerful agent for the destruction of normal tissues surrounding the diseased area. That this is an ever-present danger even with the most careful screening is evidenced by the huge fistulæ that occasionally occur even in clinics conducted by experienced operators. These fistulæ may not appear until weeks or months after an application, so that a case which at first appears eminently successful may in time prove a distressing failure even though the disease may have temporarily vanished.

It would be unwise at the present time to lay down any didactic rules for dosage inasmuch as ideas on this subject are changing rapidly, and any statement that we might make is liable to be out of date in a few months. The reader is therefore advised to inform himself on this subject by referring to the current literature. It may be said that the present tendency is toward larger and more intensive doses. In our own practice we are using from 3000 to 4000 millicuries, but many operators, especially those who possess the advantages of emanations, employ much larger doses.

It has been a well-nigh universal experience that the full benefit of the treatment must be secured at the first application. Repeated applications not only are of little or no value, but may be productive of serious harm, especially in the formation of fistulæ, or in creating a severe sclerosis of the surrounding tissues.

Frequent applications sometimes produce very rapid and brilliant results,

but there is greater danger of injury to the normal tissues. Vesical and rectal tenesmus following a given treatment constitute a serious warning that the radiation has produced some injury in the tissues surrounding those organs. After such a danger signal caution must be exercised both in the matter of later dosage and in repeating the treatment too soon. Inasmuch as the destruction of normal tissues is the result of imperfect protection we are accustomed to make most of our applications with the patient fully anesthetized. In this way the various protective measures, described in the section on Technic, may be carried out with much greater precision.

When a case is presented in which there is a large cauliflower mass in the vagina the question arises as to whether it is better to curet the mass first or to apply the radium at once and to depend on it for the removal of the growth. It is entirely possible to cause such a growth to melt away by frequent applications of radium. We do not, however, recommend this method, for as the growth extends well down into the vagina it is difficult to apply the radium without exposing too much the normal vaginal wall. We advise, therefore, that the excrescent mass be first lightly removed. The curet, if used, should not be carried too deeply, for the object is merely to remove a mechanical obstruction to the application of the radium. The radium may be inserted at the time that the cureting is done. In many cases the curet is not necessary, as the mass may be removed sufficiently with the finger. If this can be done it is preferable to using the curet.

In the preceding edition of this book we showed that certain inoperable cases may be made operable by the use of radium, and recommended this procedure whenever possible. Our more recent experience has led us to abandon this practice, as the results have been almost universally discouraging. Many other operators, notably Burnam and Clark, have substantiated this view.

The prophylactic use of radium after a radical operation requires special care. Our observations indicate that postoperative cases are especially susceptible to fistula formation. Some operators leave radium in the vaginal wound as a routine measure in completing a radical operation. This procedure we do not recommend, as radium is especially destructive when applied to freshly cut tissues. If radium is to be used as a prophylactic we prefer to apply it after the vaginal wound is completely healed, and then only in modified doses. Conservatism in this respect is especially urged, for the welfare of a patient who has been cured of a cancer of the cervix cannot be said to be greatly improved if the final result is a permanent vesical or rectal fistula.

In making applications of radium for local recurrences in the vagina the same care must be exercised as in employing radium as a prophylactic in the healthy vagina, for in recurrent cases the danger of causing fistulæ is even greater. If the recurrence is discovered early, one treatment often suffices to cause the disease to disappear. In a case of this kind a maximum dose should not be

given. We are accustomed to use 50 to 100 mg. from four to twelve hours, depending on the condition of the vaginal tissue and progress of the disease. That is to say, for a small nodule in unimpaired tissue the dosage would be greater than for a recurrence with ulceration.

In cases of metastatic extension into the regional lymph-glands radium, in our experience, has failed either to check the progress of the disease or effectually to control the pain.

As to the after-treatment of patients treated by radium for cervical cancer there is not much to be said. The average stay in the hospital is from three to seven days, depending on the amount of constitutional reaction. Many patients show absolutely no general effects from the treatment. In others, especially in those much depleted by the disease, various reactions appear, chiefly in the form of nausea and vomiting, which may persist for two or three days. Sometimes it lasts only while the treatment is in process and disappears as soon as the radium is removed. Rectal or vesical tenesmus may sometimes become a disturbing symptom and may persist for several weeks, requiring sedative or even local treatment. Patients suffering a reaction of this kind are in danger of developing a fistula later. It can usually be avoided by proper protection of the vaginal walls and close packing with gauze.

The occurrence of leukorrhea following operation is a matter of considerable variation and doubtless depends on the nature of the growth and the amount of dosage. In some cases the secretion is very profuse, lasting for days or even weeks, while in others it is hardly perceptible. When the discharge is profuse the patient should be carefully nursed and given douches sufficient in number to keep the vagina as clean as possible. These patients should be kept in the hospital until the discharge is under control. In some cases there is a rise in temperature as a result of toxic absorption. If there is a temperature reaction the patient should be kept under observation until the temperature subsides, for the rise may indicate an inflammatory pelvic process which is sometimes induced by the action of the radium. If a pelvic peritonitis ensues the patient should be treated by non-operative methods, chief reliance being placed on frequent hot douches.

**Heat Treatment.**—To J. F. Percy the profession is chiefly indebted for a revival of the method of treating cervical cancer by heat. Many years ago Byrne achieved brilliant results by this method, but since his time no one has been able to repeat his success. Percy states that his work is based on laboratory experiments, which show that cancer cells cannot be successfully transplanted after an exposure of 45° C. for ten minutes, while normal tissue cells can stand a temperature of from 55° to 60° C. without being devitalized. The reason that the use of heat has accomplished so little in the treatment of cancer is due to the improper manner by which it has been applied.

To quote Percy:

"Experimental work has shown that a low degree of heat has a much greater penetrating power in a mass of cancer than has a high degree. High degrees of heat carbonize the tissues, inhibiting penetration; low degrees of heat coagulate the tissues, encouraging heat dissemination. High degrees of heat, with the resulting carbon core, prevent drainage in the cancer mass. This permits, in a certain number of cases, the absorption of an excessive quantity of broken-down cancer cells, which are dangerous to the life of the patient. When the temperature in the heating iron is the right degree for the greatest penetration, its shank can be wrapped with surgeon's cotton and remain there for forty minutes or more. The color or texture of the cotton will not be altered in any way by this degree of temperature; and this merely emphasizes the fact that a burning temperature is not used."

It will thus be seen that this procedure is in no sense a burning or cauterization of the parts, for this, according to Percy, "only defeats the effort to get a maximum penetration of heat." Among the advantages claimed for this method is the freedom from danger of injuring the rectum, bladder, and ureters; and the quick sealing of the lymphatics and blood-vessels, which not only prevents further dissemination of the disease, but is a safeguard against the spread of infection.

Percy's operation consists essentially in applying electrically heated irons wrapped in cotton to the cancerous field. The irons are kept at a carefully regulated, moderate temperature, being introduced through a specially devised water-cooled vaginal speculum. The length of time required for application to a certain part is determined by an assistant, who, through an abdominal opening, grasps the malignant mass and announces when the heat is approaching a danger point. By this method the gross malignant mass is usually removed at one sitting. Repeated operations are sometimes necessary. For a detailed description of the technic of application of Percy's cautery see Part III.

This work is too recent to permit of definite reports as to curability, but, considering the former excellent results of Byrne, the method possesses considerable promise.[1]

**Palliative Treatment of Cancer of the Cervix.**—When a case of cancer of the cervix is found to be inoperable, and radium or the heat treatment is not available, the first indication is to remove the sloughing necrotic part of the disease, for from this friable, infected tissue the patient is bleeding and absorbing toxic

[1] Since the above was written the Percy cautery has been extensively tried out in this country. Opinions as to its value vary considerably, but the most reliable evidence is in its favor, as is also the result of our own experience. There is no doubt that this method of treatment requires skill and experience in order to avoid certain disastrous complications. Of these, the most important is the fatality associated with ulcerations of the intestinal tract similar to that which may occur after extensive cutaneous burns. Other complications are the formation of fistulæ, the occurrence of a late secondary hemorrhage, and septic intoxication from sloughing tissues. According to Smith, the fistulæ usually heal spontaneously in contrast to the fistulæ following radium, which practically never heal. The secondary hemorrhages may be avoided by ligating the internal iliac and ovarian vessels at the time of the operation. If this precaution is not taken secondary hemorrhages occur in 40 per cent of cases.

The most complete report on the use of the Percy cautery has been made by Smith, who records 100 cases treated at the Mayo Clinic. Of these it was possible later to perform a radical extirpation of the uterus in 26 cases, the time chosen for the hysterectomy being about four weeks after the cautery treatment. In 19 of the 26 cases thus operated on no carcinoma was found in the specimen removed at the final operation.

Smith's results compare favorably with, if they do not surpass, the best reports from the use of radium in the same class of cases.

substances that produce the cachexia, loss of weight, fever, and other general constitutional symptoms. The removal of this tissue consists of a thorough cureting down as nearly as possible to normal tissue, followed by deep cauterization. This procedure must always be carried out with care not to perforate the uterus, an accident that is especially liable to happen in cureting infiltrating cancer of the posterior lip, in which there is danger of entering Douglas' fossa, This is almost invariably followed by fatal peritonitis.

Curetment and cauterization, as a rule, produce a marked general improvement in the patient's health. Bleeding is temporarily checked, while the nauseating discharge is made less watery and abundant, and the foul odor is stopped or lessened for a time. The general appearance of the patient is improved, and there is sometimes some gain in weight, while the general mental depression is relieved.

The patient must be kept on frequent douches of formalin (1 per cent.) to control the odor. After a time, as the disease again grows, the old symptoms return and the cureting and cauterization must be repeated, and so on until the patient dies. After a time severe boring, unbearable pain ensues. This can best be treated at first with frequent doses of dionin, for which in the later stages morphin must be substituted in amounts large enough and frequent enough to keep the patient comfortable.

Other palliative operations are sometimes used besides curetment and cauterization. Krönig, after performing an "exploratory laparotomy" and finding the case inoperable, ties the hypogastric, ovarian, and round ligament arteries. This seems to delay the progress of the disease somewhat and prevents bleeding for a considerable time until a collateral circulation is established.

Chlorid of zinc, applied to the crater in the uterus made by the cureting and cautery, has been much used. It is sometimes valuable when applied by skilled hands, but its effect on the tissues is difficult to control, and there is always danger of perforation of the uterus or erosion of the uterine vessels. It is best applied on small pledgets of cotton, which are packed into the cavity. At the end of about a week the pieces of cotton may be removed *en masse* with a complete cast of the cavity adherent. Chlorid of zinc is not recommended as a routine measure.

An excellent palliative measure for the control of the discharge and alleviation of the foul odor is the employment of acetone, as recommended by Gellhorn:

The patient lies on her back with hips elevated by pillows. Through a Ferguson's speculum 3 or 4 drams of pure acetone are introduced into the vagina and left in contact with the diseased area for about four minutes. The acetone is then removed by pledgets of absorbent cotton and a glycerin tampons packed in the vagina to be removed in twenty-four hours.

It is important to avoid allowing the acetone to come in contact with the external skin, as it causes intense burning pain.

Another less effectual means of keeping the vagina clean is the frequent application of iodin to the diseased area.

Under careful palliative treatment patients may live from one to two years.

Unquestionably the best palliative treatment for inoperable and recurrent cases is that afforded by radium. On account of the limited supply of radium and the lack of knowledge of its use the treatment at present is restricted to a few fortunate localities. It is necessary, therefore, in the majority of cases to resort to the older time-honored methods for palliative treatment.

## CANCER OF THE BODY OF THE UTERUS

We prefer to treat the subject of cancer of the uterine body separately from that of the cervix, because the two diseases are quite distinct both in their clinical aspects and in their pathological processes.

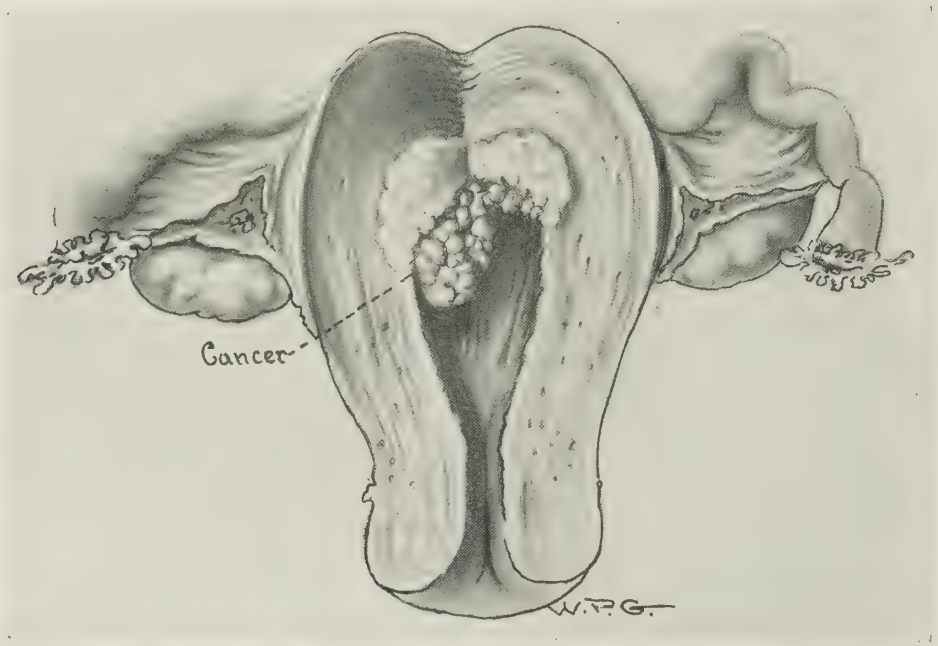


FIG. 122.—ADENOCARCINOMA OF THE BODY OF THE UTERUS.

The disease is beginning in the upper part of the canal and is extending both inward into the muscular wall and outward toward the canal. In this case the growth has a papillary appearance.

The anatomic type of cancer of the body is invariably that of adenocarcinoma, although the process may develop into advanced stages in which the glandular arrangement is no longer apparent. The histologic picture may then be one of carcinoma simplex, in which the carcinomatous cells are massed together with no definite arrangement. Sometimes a metaplasia takes place, like that which frequently appears in cancer of the endocervix, whereby the cells take on a squamous character, even to the formation of cornified pearls.

The growth originates in the mucous membrane, and tends both to proliferate into the uterine cavity and to infiltrate the muscular wall of the uterus, one of these tendencies usually predominating. In the typical case that is

growing outward the uterine cavity the microscopic appearance is that of long-branching tendrils of a papillary nature. When the disease encroaches on the muscular wall glandular offshoots are seen invading the muscle below the normal line of demarcation, between muscle and endometrium. Macroscopically, upon opening the uterine cavity the growth appears as an irregular elevation of the endometrium, the surface of which in some places may be smooth and waxy, in others papillomatous. The cut surface is usually somewhat lighter in color than that of the normal uterine tissue, and a rather distinct outline can be made out between cancer and muscle tissue. The disease gradually en-

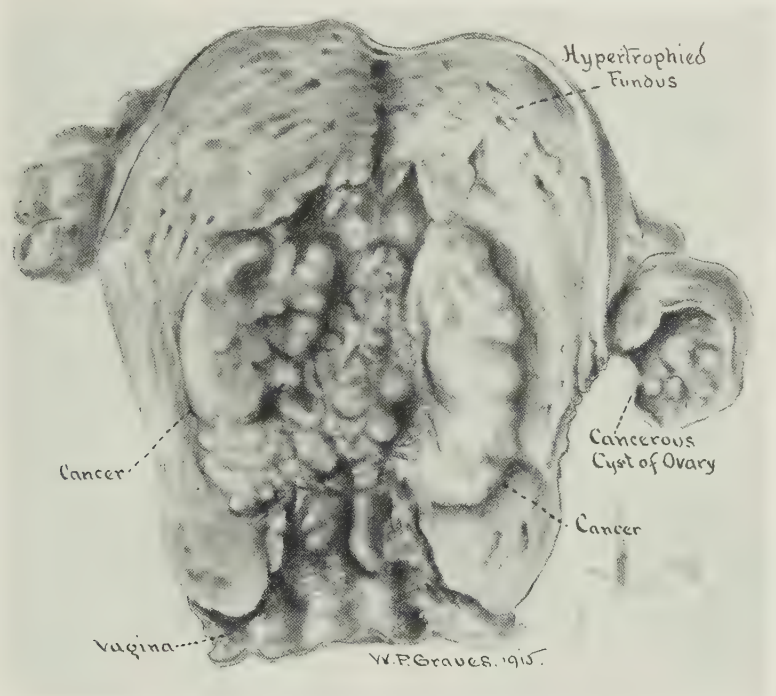


FIG. 123.—ADENOCARCINOMA BEGINNING NEAR THE INTERNAL OS.
This tumor has metastasized in the ovaries.

croaches on the uterine wall until in advanced cases the musculature may be little in evidence. In the course of time it may break through the outer wall and become disseminated to neighboring parts. Unlike cancer of the cervix, it usually does not invade the parametrium excepting by direct extension, a process which indicates a late stage of the disease. Metastasis to the regional lymph-glands is later than in cancer of the cervix. Occasionally cancer of the body metastasizes to the tube and ovary in a comparatively early stage of its growth, an extension rarely seen in cancer of the cervix.

Cancer of the body has its principal incidence later in life than cancer of the cervix, the figures of Koblanck showing that in 50 per cent. of cases it occurs

between the ages of fifty and sixty. It is quite rare to find it in patients under forty. It is seen only about one-eighth as often as cancer of the cervix, according to statistics.

Nulliparous women seem to have a special predisposition to this form of cancer, a fact that still further differentiates it from cervical cancer.

Cancer of the body is quite often found in association with uterine fibroids, whereas the combination of fibroids with cancer of the cervix is comparatively rare. As the process frequently originates in the mucous membrane covering the myoma, it is thought that the cancerous growth is stimulated by trauma exerted by the fibroid on the overlying endometrium.

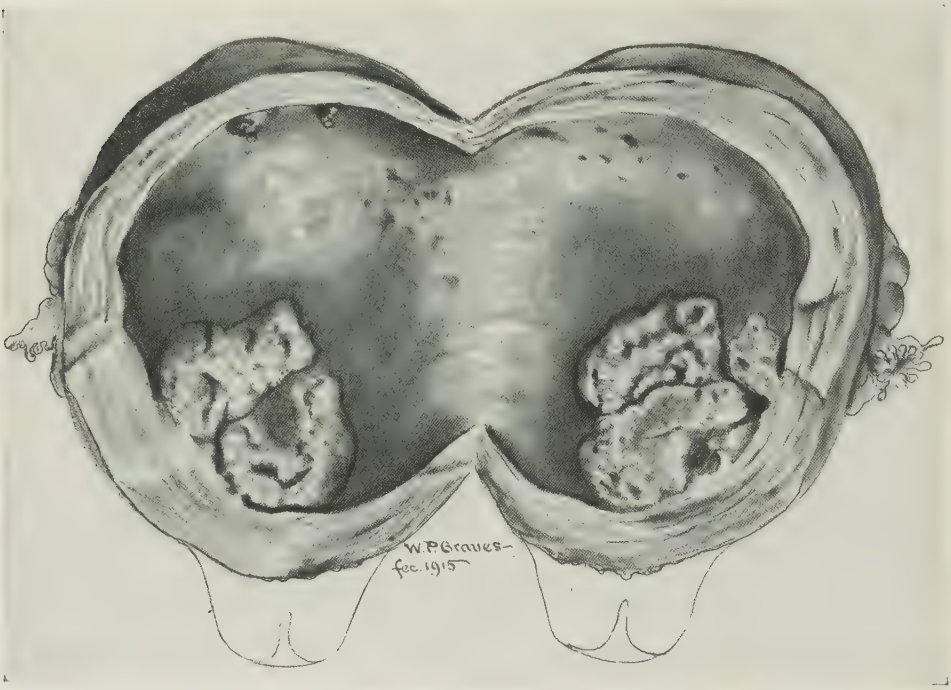


Fig. 124.—Hydrometra.

In this case the patient, aged sixty-two at the time of operation, had never menstruated, though in earlier life she had had periodic molimina. The tumor seen in the cavity is a papillary adenocarcinoma, probably of recent development. The contents of the uterine cavity were of a serous character with brownish tinge. The outline of the cervix has been sketched in to show the absence of a complete canal. The operation consisted of a supravaginal hysterectomy, the cystic nature of the uterus not being discovered until the specimen was opened.

Cancer of the body is especially favorable from a surgical standpoint because not only is its progress slow, but it usually gives early warning of its presence. It makes its appearance first by increased uterine secretion and then by bleeding. This bleeding, coming as it frequently does after the menopause, attracts the immediate attention of the patient, so that she is apt to seek medical advice in time for successful surgical treatment. When the disease occurs before the menopause its detection from clinical symptoms is more difficult. The bleeding at this time is apt to appear only as a profuse menstrual

period, and the mistake is often made, both by the patient and her doctor, of regarding the menstrual disturbance merely as an indication of the change of life. The progress of the disease, however, is usually so slow that the persistent hemorrhages finally excite suspicion in time for surgical cure. When a cancer of the body is associated with a uterine fibroid the bleeding has no definite diagnostic characteristic which would differentiate it from that seen in an ordinary submucous myoma. If, therefore, in a case of bleeding fibroid non-operative treatment is decided on for any reason, the uterine cavity should at least be explored to exclude the possibility of the presence of a cancer. This procedure is especially important if the *x*-ray or radium is to be used, for

FIG. 125.—PEDUNCULATED ADENOCARCINOMA OF BODY OF UTERUS.

there seems little doubt that in cases of myoma complicated by carcinoma or sarcomatous degeneration the malignant process is stimulated to new activity by the influence of the rays.

The **diagnosis** of cancer of the body should always be made by the microscopic examination of curetings. In a great many cases, where the uterus is soft and the cervix is patulous, a piece of the endometrium can be removed by means of a small curet without anesthesia.

Clinically, cancer of the body must be differentiated from uterine insufficiency, mucous polyps, chronic interstitial endometritis, cancer of the cervix, and submucous fibroids, and the only sure way of accomplishing this is by means of the microscope.

Microscopic differentiation between cancer of the body and certain benign conditions of gland hyperplasia of the endometrium is sometimes difficult. In

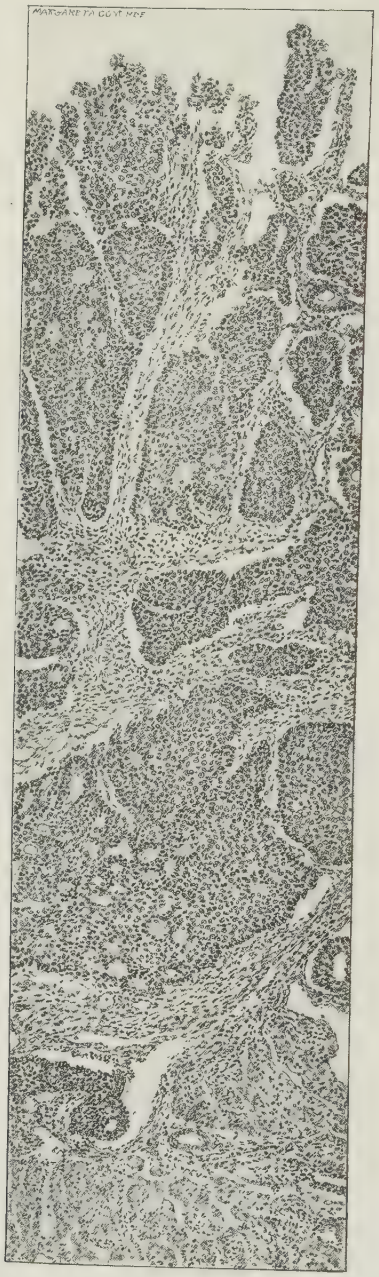

Fig. 126.—Adenocarcinoma of Body of Uterus.

gland hyperplasia there is often a suggestive heaping-up of the epithelial cells lining the glands and an excessive branching of the glands themselves. Occa-

sionally too, there is a dipping of the glands into the muscular tissue beyond the normal boundary line of the endometrium. These eccentricities of non-malignant hyperplasia must be borne in mind, and not be interpreted as manifestations of malignancy without further evidence. The final diagnosis of cancer must be made by irregularities of the cell form, by abnormal nuclear figures, by unevenness in the staining of the nuclei, and by lack of continuity in the basal membrane of the glands.

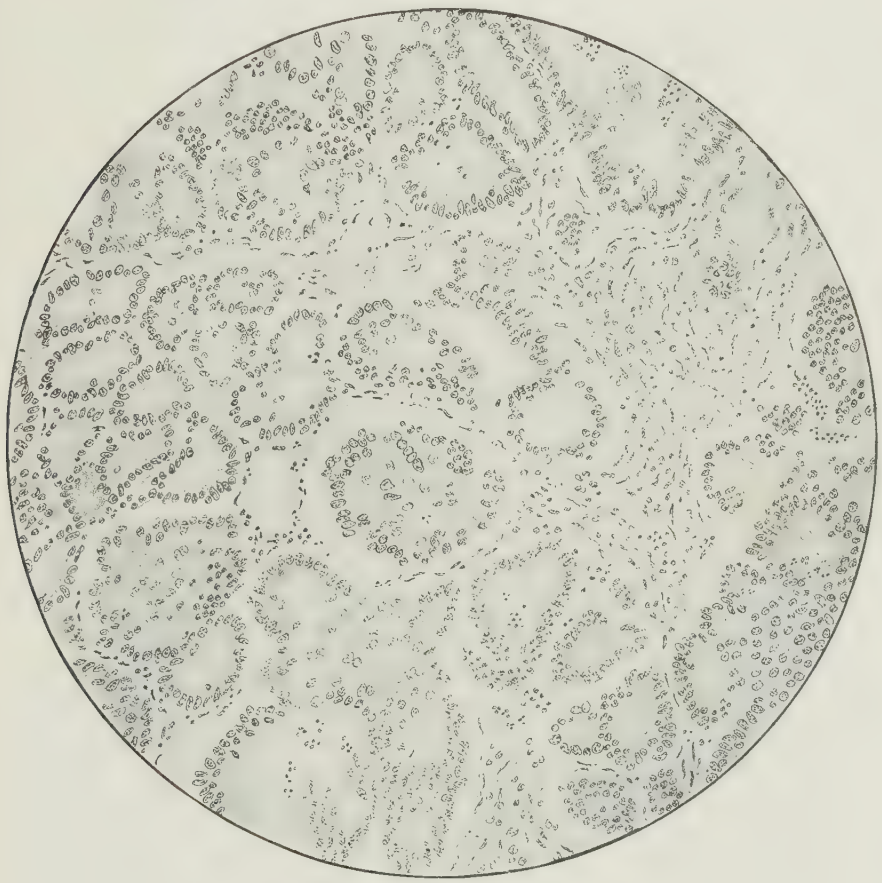

FIG. 127. — ADENOCARCINOMA OF THE ENDOMETRIUM.

High power. To illustrate the increase in number of the glands which lie close together and are irregular in outline. The epithelial cells have lost their regular placing, appear to be jumbled together, occur in more than one layer, and contain nuclei larger than normal and varying much in size.

When the diagnosis of cancer is established the treatment is immediate radical operation.

The operation for cancer of the body is similar to that for cancer of the cervix, except that it need not be so extensive. Removal of lymph-glands is rarely necessary, while a wide dissection of the parametrium is not required in most cases. Moreover, as cancer of the body has little tendency to extend

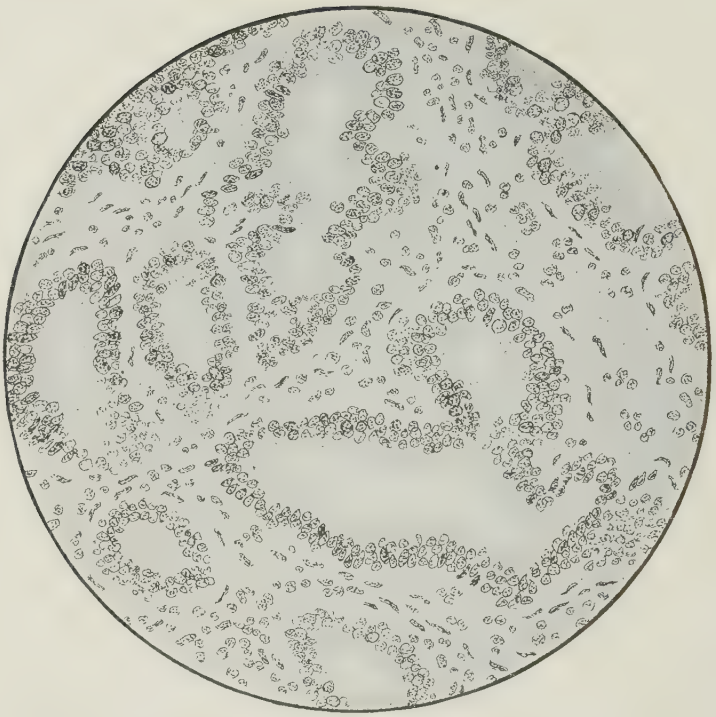

FIG. 128. —ADENOCARCINOMA OF THE ENDOMETRIUM.

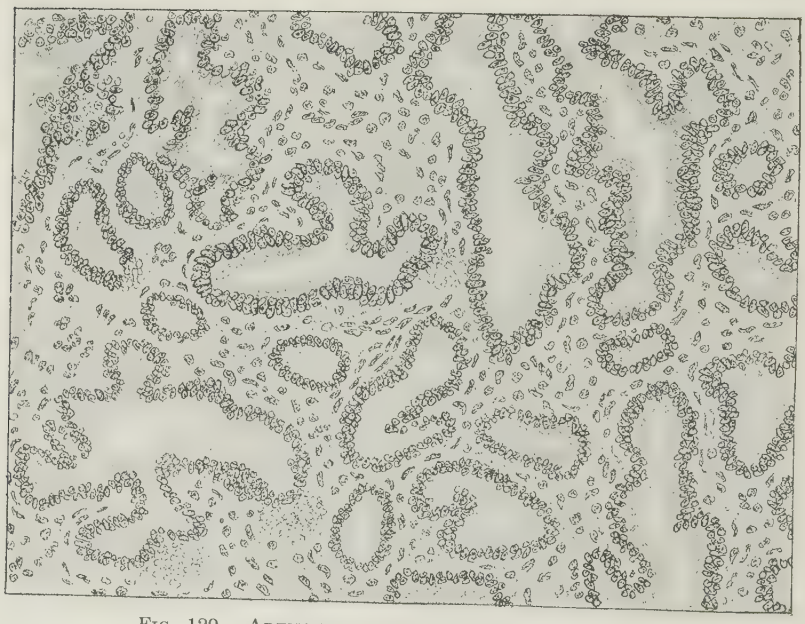

FIG. 129.—ADENOCARCINOMA OF THE ENDOMETRIUM.

downward, there is not the need of removing the upper part of the vagina as there is in operating for cancer of the cervix. The operation for cancer of the body, therefore, is very much less difficult than that for cervix cancer, and the primary mortality is correspondingly lower.

*It is of extreme importance that the ovaries should be removed,* on account of the frequent occurrence in them of implantation metastases.

FIG. 130.—ADENOCARCINOMA OF THE ENDOMETRIUM.

Low power to show a papillary outgrowth. We see a branching, connective-tissue stroma carrying blood-vessels, covered with epithelium lying in one to several layers. This is characteristic of the advanced adenocarcinoma growing out into the uterine cavity. The marked change can be understood if this is compared with the normal endometrium.

The prognosis as to recurrence is very good, and permanent cures should be obtained in at least 80 per cent. of cases operated on.

## CHORIO-EPITHELIOMA MALIGNUM

This term is applied to a malignant tumor that develops from the epithelial elements of placental tissue. It most commonly follows the expulsion of a hydatidiform mole, but may date its origin from an abortion or a tubal pregnancy, or even a normal pregnancy. The tumor usually appears first as a nodular excrescence growing from the surface of the uterine canal or from the lumen of the tube. The growth is very vascular, often having the appearance of a hematoma, and tends to bleeding and necrosis. Metastases soon appear on

the wall of the vagina or in the neighboring pelvic organs, and spread rapidly by the blood circulation to distant parts of the body, especially to the lung. The disease, if not checked by surgical interference, is usually very fatal, destroying the patient with extraordinary rapidity, but sometimes abruptly ceases in its progress even after the appearance of distant metastases. Its onset may follow the abortion or mole from which it takes its origin almost immediately, or it may not appear for days, months, or even years later.

Fig. 131.—Retained Placenta, Infected.

Low power. The section consists mostly of coagulated blood. The strands of fibrin show especially. Infiltrating it are large numbers of leukocytes, mostly of the polynuclear variety. Near the top and in the center are several chorionic villi.

The history of our present knowledge of chorio-epithelioma is one of unusual interest. The disease was first described by Saenger. He thought that these tumors developed from the decidual cells of the endometrium, and gave the name *deciduoma* to the disease, supposing it to be a sarcoma. Later, Marchand described the histology more exactly, and showed that the tumor-growth develops from the epithelial cells surrounding the chorionic villi, and is, therefore, a carcinoma. This view is universally held at present, and all terms formerly used

at different times to designate the disease have given way to the name suggested by Marchand, "chorio-epithelioma," which best describes its histogenesis.

There has also been a complete change in our knowledge of the clinical course of these tumors quite as remarkable as that of our ideas as to their histology. Saenger's first 5 cases died with general metastases within seven months after abortion, and he regarded the disease as absolutely hopeless. In 1896 Apfel-

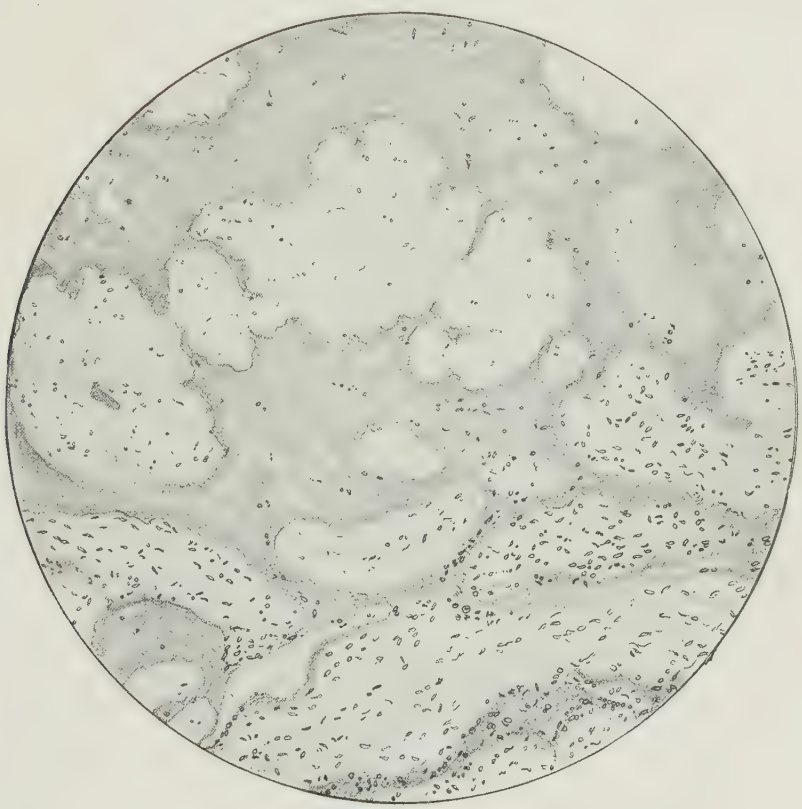

FIG. 132.—PLACENTAL POLYP.

Low power. The light areas are chorionic villi, cut in various planes, which have become hyaline in places and still show their connective-tissue structure in others. They have lost their epithelial covering of Langhans' cells and syncytium. They lie in fibrous tissue formed by the organization of blood.

staedt stated that all therapy against these most malignant of all known neoplasms was madness. Nevertheless, six years later Polano reported 50 per cent. and Teacher reported 63.3 per cent. of cures.

Although these percentages are today regarded as unduly high, yet the number of operative cures is very large, while numerous instances have been reported where tumor masses which had been left behind during incomplete operations have eventually healed spontaneously. We see, therefore, the great-

est contrasts in the clinical picture of different cases, ranging from the stormiest and most malignant course to spontaneous and permanent retrogression.

The first instances of spontaneous cure were reported by Pick and Schlagenhaufer, the former describing a case of vaginal metastasis following abortion. Schlagenhaufer concluded, from the observations of his case, that there are two clinical forms of the disease. The first is extraordinarily malignant and quickly

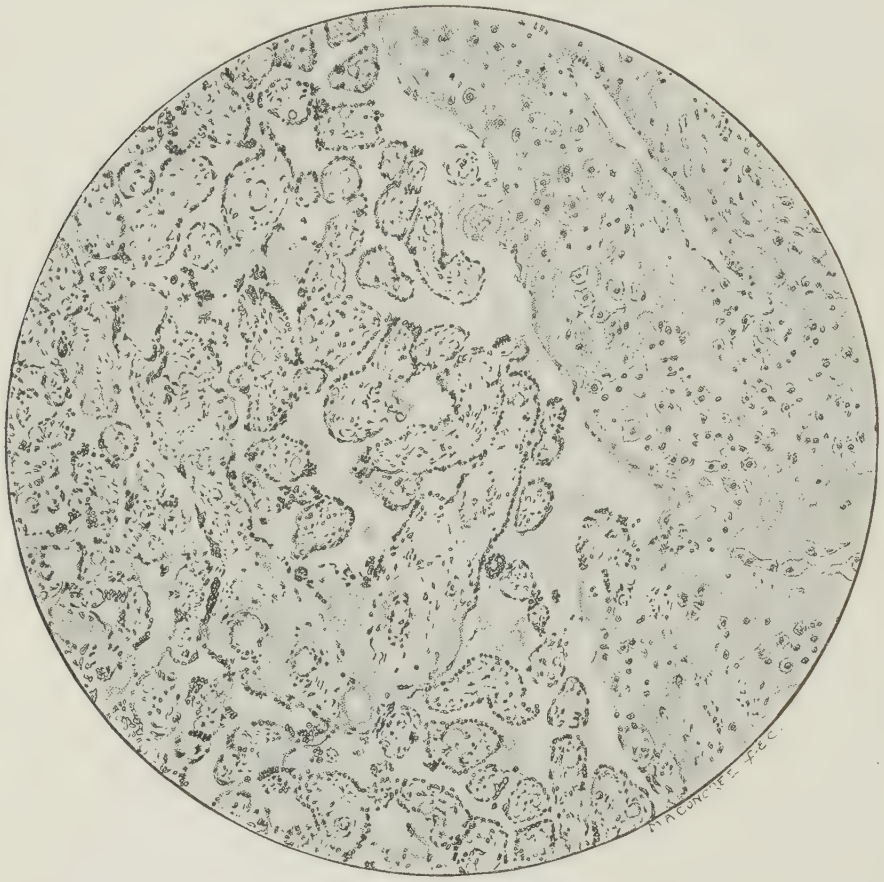

Fig. 133.—Placenta at Full Term.

Low power. On the right is an area of decidua consisting of greatly enlarged cells derived from the stroma of the endometrium. The enlargement takes place mostly in the protoplasm of the cell, the nucleus enlarging proportionately little. On the left are chorionic villi cut in various planes. They consist of a loose connective tissue containing comparatively large blood-vessels, covered by a layer of Langhans' cells and syncytium. The intervillous space is normally filled with blood. The small, dark areas are fragments of syncytium.

overwhelms the organism with metastases, while the second form is benign from the outset. He further stated that the histologic appearance of the two forms is alike.

In order to understand the microscopic appearance of chorio-epithelioma it is necessary to review the histology of the chorionic villus, from the epithelial elements of which the chorio-epithelioma has its origin. The chorionic villus

is clothed with two layers of epithelium, the outer being termed the "syncytium," and the inner the "layer of Langhans." The term "syncytium," from its derivation, denotes a fusing together of cells, and describes the outer layer, in that it consists of a continuous mass of darkly staining protoplasm in which are more or less regularly placed nuclei. There are, therefore, no definite cell boundaries. The continuous cell mass is occasionally interrupted by open spaces or vacuoles. The underlying layer (cells of Langhans) is composed of a single column of large bright epithelial cells with well-marked boundaries and weakly staining nuclei.

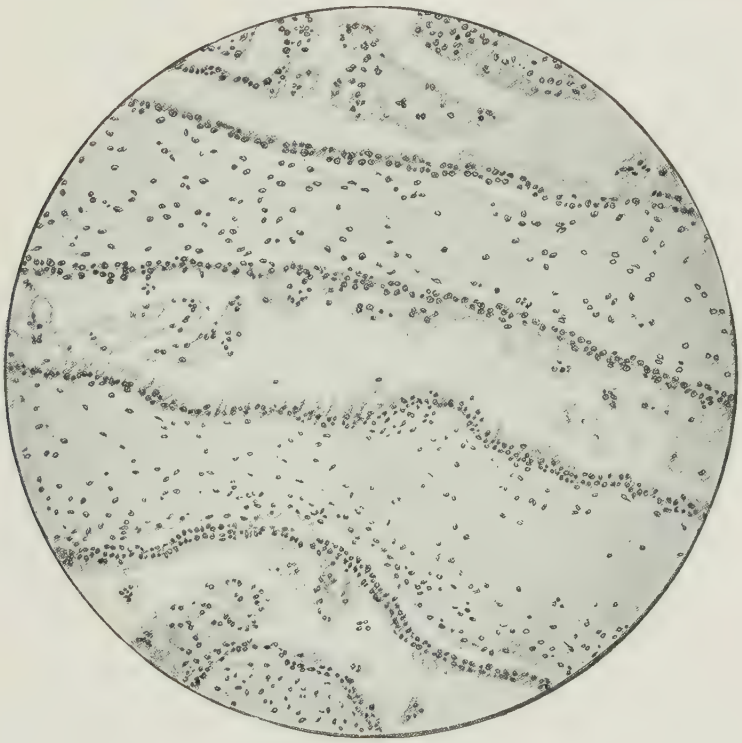

FIG. 134.—HYDATID MOLE.

Low power. Parts of two chorionic villi are seen running across the field. They are tremendously swollen, as may be seen if this is compared with the drawing of the placenta at full term. The layer of Langhans' cells covered with syncytium are well shown on the surface of the villi. On the space between the villi in the center are several fragments of syncytium. This space is normally filled with blood in which these fragments lie.

They look like squamous epithelium, and are, in fact, derived from the fetal ectoderm. The outer layer (syncytium) is derived from the inner layer (Langhans), so that *both layers are fetal in origin*. Both layers in the normal placenta have a tendency to proliferate and grow outward into the space between the chorionic villi. The syncytial covering heaps up and pushes out into polypoid processes that may become broken off. Hence, isolated irregular syncytial masses may often be found in the intervillous spaces. In this way syncytial elements are sometimes taken up by the blood-current and transported to distant organs, especially the lungs. The layer of Langhans is also prone to proliferate,

and may break through the surrounding syncytial covering and grow in irregular masses of cells that include fragments of the syncytium (see Fig. 135). The pro-

FIG. 135.—CHORIONIC VILLUS, SHOWING GROWTH OF LANGHANS' CELLS BREAKING THROUGH THE SYNCYTIUM INTO THE INTERVILLOUS SPACE.

Fragments of syncytium are seen in the sprouting mass of Langhans' cells. On the right is a collection of Langhans' cells, more highly magnified, surrounding syncytial fragments. (After Winter.)

liferation of these two epithelial elements may be considerable and yet be within physiologic bounds.

FIG. 136.—SYNCYTIUM AND LANGHANS' CELLS.

Two chorionic villi are seen, showing the outer syncytial envelope and the inner layer of Langhans' cells. In the center is a mass of proliferating Langhan's cells in which are scattered fragments of syncytium. (After Winter.)

In chorio-epithelioma exactly the same overgrowth takes place without change in the appearance of the cells, excepting that it progresses to a malignant growth.

When the fact became known that the disease might be either benign or malignant, every effort was made by pathologists to discover some distinguishing histologic mark by which the two forms might be differentiated. These efforts have been unsuccessful. Marchand, Aschoff, Zagorianski, Kissel, v. Franque, Albrecht, Hormann, and others agree that we have absolutely no histologic criterion for determining the malignancy of these tumors.

Moreover, a further difficulty in diagnosis exists in the fact that the tumors exactly resemble the normal fetal tissue.

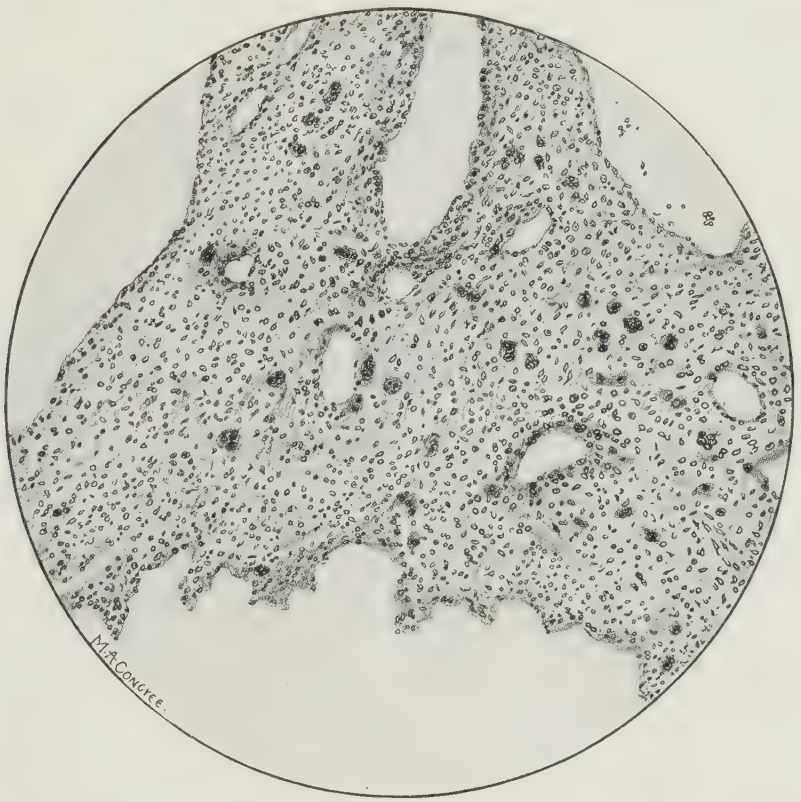


Fig. 137.—Syncytium in the Decidua.

Low power. This illustrates the wandering of fragments of syncytium in the decidua. The dark masses consist of syncytium which were found in the decidua. Several glands are seen, as this is endometrium.

Hitschmann and Cristofoletti came to the following conclusion:

"As a matter of fact, we are convinced that a histologic difference is entirely improbable. We know of absolutely no morphologic and biologic difference between the *physiologic* fetal tissue and the *pathologic*. The more carefully we study the earliest phases of placenta formation and compare them with chorio-epithelioma, the more we feel justified in the statement *that between trophoblast* (fetal tissue) *and chorio-epithelioma there is no difference.*"

The same writers call attention to the biologic resemblance that exists between the trophoblast, or fetal tissue, and chorio-epithelioma. "All the characteristics of the tumor cells are to be found in the normally functioning trophoblast. The enormous capacity for growth of the fetal cells, the destruction of maternal blood-vessels are apparent in both, excepting that in the physiologic tissue there is a local and time limitation. The relation of the fetal cells to the maternal tissue is just the same. *The most important function of the trophoblast is the destruction of the maternal tissue, especially the erosion of the blood-vessels.* In this way does the young egg come into relationship with the mother's blood, the intervillous circulation becomes established, and the nourishment of the egg remain assured. The entire egg rests within the maternal blood-vessels and is bathed in maternal blood.

"These same characteristics we find in the chorio-epithelioma. There is the same destructive faculty, the same elective behavior toward the maternal blood, and, therefore, the almost exclusive extension by way of the blood-stream. Both tissues have no supporting tissue structure, no individual blood-vessels, and both are dependent for their nourishment on the circulating blood of the mother. The fetal cells of the trophoblast are, therefore, morphologically and biologically identical with the cells of the malignant chorio-epithelioma. Therefore, in diagnosing a chorio-epithelioma no safe conclusion may be drawn from the destruction of the maternal tissue as to its malignancy, because destruction of the maternal tissue is the most important function of the trophoblast." (Translation.)

**Classification of Chorio-epitheliomata.**—Numerous attempts have been made to classify chorionic tumors on the basis of the question of malignancy. Thus Teacher divides them into (1) the simple hydatidiform moles, (2) the malignant or destructive hydatidiform moles, *i. e.*, moles that show an increased trophoblastic overgrowth, and a tendency to invasion and metastasis, (3) the pure chorio-epitheliomata showing no chorionic villi; and (4) a group between the last two, consisting for the most part of chorio-epithelium, but showing some evidence of villi.

Ewing classifies chorionic tumors as: (1) hydatidiform mole, (2) chorio-adenoma destruens, and (3) chorio-carcinoma.

Emil Novak wisely limits the classification to two heads, namely, (1) chorioma benignum or hydatidiform mole, and (2) chorioma malignum or chorio-epithelioma, on the ground that the tumors are either benign or malignant.

Novak also emphasizes the fact that hydatidiform mole, which he regards as a neoplasm rather than as a "degeneration," occurs much more frequently than is commonly supposed. He regards it as a frequently overlooked cause of abortion. He also points out very significantly that in view of the very common occurrence of hydatidiform mole, and the rare appearance of the true chorio-epithelioma, the proportion of cases of mole followed by malignancy must be extremely small. Indeed, he goes so far to estimate it as a small fraction of 1 per cent. Of course, he includes in this estimate the cases of early hydatidiform change which can be detected only by the microscope. If these figures of Novak are right they have an important bearing on the clinical treatment of mole. "It is quite certain," he says, "that thorough evacuation of the uterus will cure hydatidiform mole in the majority of cases."

**Symptoms.**—Chorio-epithelioma usually makes itself known by repeated uterine hemorrhages following an abortion or a mole. Bleeding is always the characteristic symptom, no matter where the tumor is located, and is due to the corrosive action of the tissue on the walls of blood-vessels with which it comes

in contact. Cureting brings about only a temporary cessation of the bleeding, which is apt to be severe and depleting. The patient becomes rapidly anemic and cachectic. Albuminuria is a very frequent accompaniment. A second cureting reveals a new mass of tissue in the canal of the uterus. A diagnosis by microscopic examination of the curetings is very difficult to make, as is explained above, and patients are often lost as a result of a negative report from the pathologist. It is extremely necessary, therefore, to take into account the clin-

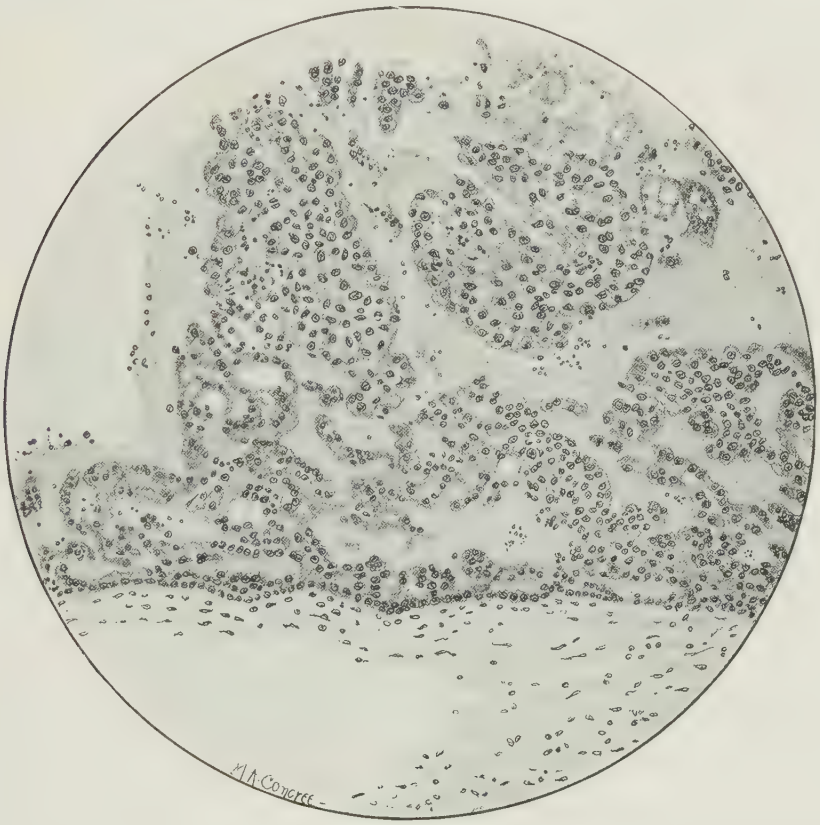

FIG. 138.—CHORIO-EPITHELIOMA.

Low power. At the bottom is the edge of a chorionic villus covered with a regular layer of Langhans' cells. In the middle, lying on this, is syncytium. To the left of this and above it are masses of Langhans' cells. Near the top and near the right edge are large fragments of syncytium having the larger, deeper staining nuclei and deeper staining protoplasm, the whole floating in blood.

ical course of the disease, without relying too much on the findings of the microscope. After metastases occur the diagnosis is simple, but it is then usually too late for treatment, though cases of spontaneous cure even at this stage have been reported.

Metastases frequently occur in the vagina, and sometimes the first evidence of the disease is seen here, the chief symptom being bleeding. On account of the corrosive action of the tumor and the friability of its tissue, metastatic emboli

slip very readily into the blood-stream and are carried to distant parts of the body. The embolic masses when lodged grow and corrode the neighboring blood-vessels, causing local hemorrhages. Sometimes symptoms from the metastatic growths give the first warning of the disease without uterine manifestations. Metastases to the lungs are especially common, and cause pulmonary hemorrhages, or they may be localized in the brain, liver, or kidneys, etc.

In making a diagnosis of chorio-epithelioma, and coming to a decision as to the treatment, the surgeon often finds himself in a serious predicament. The situation which presents itself in a suspected case is somewhat as follows:

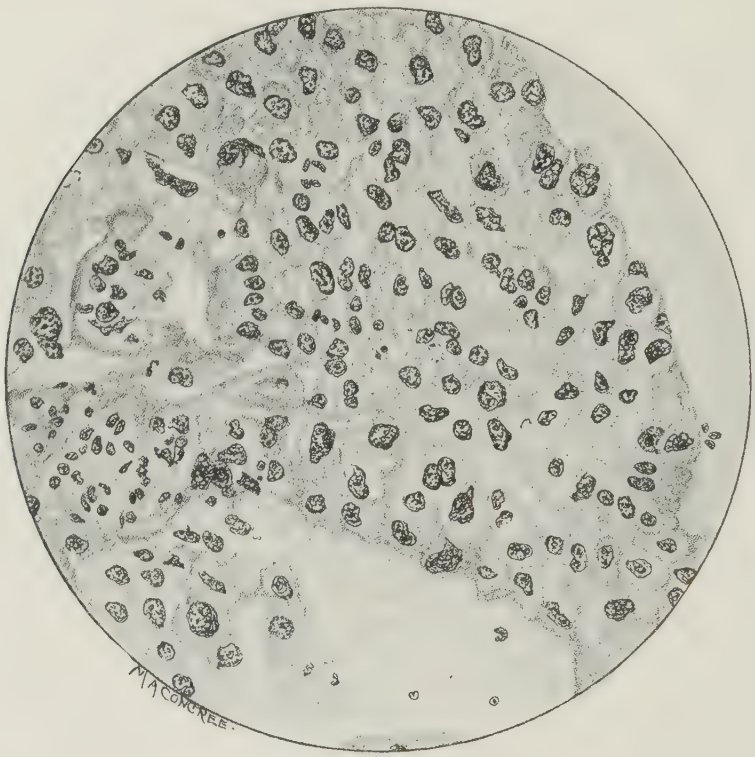


Fig. 139.—Chorio-epithelioma.

High power. This tissue consists of Langhans' cells. The nuclei and cell protoplasm do not stain as deeply as they do in syncytium, the nuclei are not as large, and the cell boundaries can be seen. No cell walls are found in syncytium, it being held together by fine protoplasmic threads.

A patient, some time after delivery of a hydatidiform mole or after an abortion, begins to bleed profusely. A cureting is done, and a considerable amount of tissue is removed from the uterine canal, which, on microscopic examination, shows numerous fetal elements. Many Langhans' cells are seen in groups, and in different places may be seen great syncytial masses with large, variously formed protoplasm. Such a picture may correspond either to a placental rest or to a benign form of chorio-epithelioma, or to an early stage of a malignant chorio-epithelioma. If radical operation is done there is a chance that the

patient will be subjected to needless danger, with the loss of her pelvic organs, for there is no way of telling that the condition in the uterus is not perfectly harmless. If one does not operate, and waits for later symptoms to develop, metastases may take place and it will be too late to save the patient. Moreover, one is confronted by the fact that a curetment sometimes turns a benign form of the disease into immediate and overwhelming malignancy, as is emphatically pointed out by Hitschmann and Cristofoletti. Cases have been reported where the initial curetings have been examined and pronounced by competent pathologists as malignant, and the extirpated uteri have later been

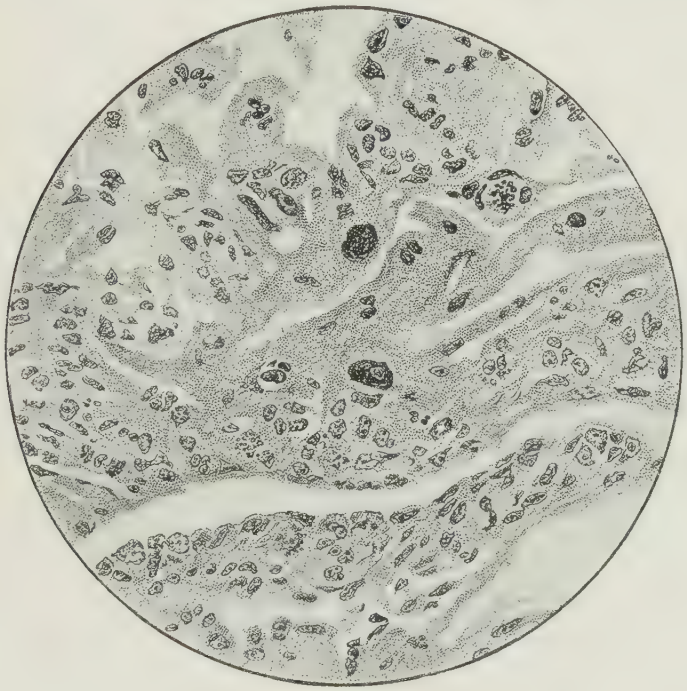

FIG. 140.—CHORIO-EPITHELIOMA.

High power. Most of the tissue consists of Langhans' cells the nuclei of which do not stain as deeply as those of the syncytium, and the cell outlines of which can usually be seen. Near the center are two syncytial nuclei which are larger, irregular in shape, and stain deeply. Near the right upper edge is a mitotic figure in a syncytial nucleus.

found to be perfectly normal. Whichever course the surgeon adopts, he is running a risk, and he must depend to a certain extent on his surgical instinct to make the right decision.

If the initial curetings show large or overwhelming numbers of grouped Langhans' and syncytial cells, immediate radical operation is advisable, especially if a hydatidiform mole has preceded. If the initial curetings show conspicuous, though not numerous, characteristic cell collections, the case is regarded with grave suspicion, and, if the symptoms have been preceded by a mole, radical operation is seriously considered. If, however, the symptoms

have followed abortion, it is justifiable to wait to see if further bleeding ensues, which, according to Meyer, will usually take place in two or three weeks if the disease recurs, though the patient should be kept under strict observation for several months, even if her catamenia is normal.

If after the careful cureting of a suspicious case, bleeding recurs, and the curetings again show the same findings, radical operation is indicated.

The surprising way in which some seemingly very malignant chorio-epitheliomata heal spontaneously, even after incomplete operations, is inter-

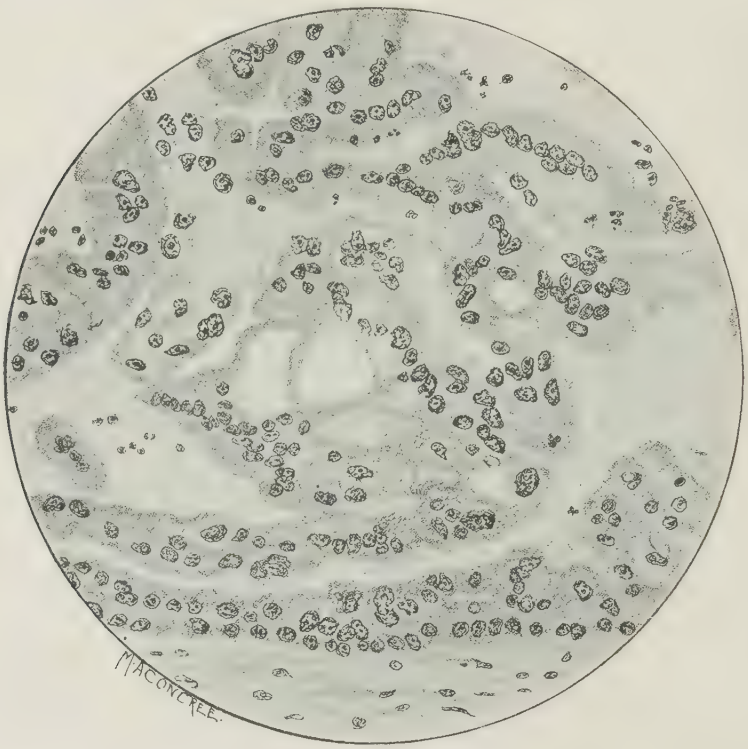


Fig. 141.—Chorio-epithelioma.

High power. At the bottom is the edge of a chorionic villus. The first layer of cells covering it consists of Langhans' cells. Covering this is syncytium and throughout the rest of the drawing are masses of syncytium lying in coagulated blood. In the lower center is seen the vacuolated appearance which syncytium has.

estingly explained by Hitschmann and Cristofoletti. These writers observed in their own and reported cases the very common occurrence of parametrial infiltration. From the study of autopsies and surgical cases they found that this infiltration does not consist in an invasion of the parametrial connective tissue by the cancerous elements, but that the thickening is due to a *thrombosis of the parametrial and spermatic veins.*

This thrombosis of the large pelvic veins may act in two ways: either it may become a new focus for metastasis and send off embolic malignant masses to

the lungs, where they may erode the pulmonary arteries and spread rapidly over the whole body, or the thrombosis, by interfering with the uterine circulation, may cause a necrosis of the tumor cells, which are very dependent for life on the maternal blood-stream, and by this necrosis cause a further thrombosis of the veins. In this way the thrombosis may become a protective barrier to metastases, and serve, at the same time, to produce disintegration and death of the entire growth. The writers present cases which convincingly substantiate this theory.

If the idea is correct, it is of very great practical value. It shows that the route of metastasis is through the pelvic veins, so that great care must be exercised in cureting or operating on these cases to avoid sending emboli artificially into the circulation by insulting the diseased tissue, which, being without supporting structure, is extremely friable and susceptible to embolism. For this reason it is inadvisable to perform the radical operation by the vaginal route. When the operation is done abdominally the first step must be to tie the hypogastric and spermatic veins in order to block the avenues for emboli. If the case is inoperable as far as the uterus and parametrium are concerned, the large veins should be tied, in the hope of interfering with the circulation of the tumor and preventing metastasis.

If the case is operable a total extirpation should be performed by the Wertheim method. The question of radical operation following the appearance of a hydatidiform mole has recently undergone an important change, especially since the appearance of Novak's convincing paper. It was at one time generally agreed that after the evacuation of a mole radical hysterectomy is not only justifiable, but even mandatory. Since, however, it has been established that malignant chorio-epithelioma follows hydatidiform mole in only a very small percentage of cases, surgeons have become much more conservative. T. J. Watkins has suggested the advisability of applying radium as a prophylactic after the removal of a mole. This is an excellent idea in view of the fact that embryonic tissue is peculiarly susceptible to the influence of radiation. We have personally adopted the suggestion of Watkins in our practice.

**Lutein Cysts.**—Ovarian cysts are frequently found associated with hydatidiform mole and chorio-epithelioma. E. Novak cites Cottalorda as finding cysts present in 59 per cent. of cases of hydatidiform mole, and in 9.4 per cent. of cases of chorio-epithelioma. It was at first supposed that these tumors were of serious pathologic significance, and that their presence indicated a malignant tendency on the part of the ovaries. More recent investigations, however, have shown that the process represents a very marked activity of the theca lutein cells surrounding the follicles, and it is now generally believed, as Novak points out, that the process is merely an exaggeration of the so-called "follicle degeneration" that is characteristic of ovaries during normal pregnancy. On account of their histogenesis the ovarian tumors associated with choriomatous growths are properly designated as lutein cysts. They are multilocular in form, the various chambers being lined with proliferating lutein cysts of the atretic follicles.

To quote Novak, "Presumably the stimulus for the formation of the theca lutein cells emanates from the embryo, probably the trophoblast. With hydatidiform mole or chorio-epithelioma it would seem that the trophoblastic overgrowth is responsible for an enormous increase and perhaps perversion of this causative stimulus, so that the ovarian response is correspondingly increased. The number of atretic follicles is increased and the lutein-like changes in the theca cells become pronounced. Even the theca cells of follicles which have long since become atretic or which have already become converted into corpora fibrosa are awakened into activity by this stimulus to which they appear to be specifically sensitive. This explains why the theca lutein cells are so often found beneath a deep layer of connective tissue, and why they often appear to be buried deep in the ovarian stroma. It was this characteristic no doubt which led Schaller and Pforringer to interpret the condition as a carcinomatous infiltration." (Jour. Amer. Med. Assoc., vol. 78, No. 23, p. 1771.)

From Novak's work it seems safe to conclude that these lutein cysts are not true neoplasms and that they should therefore be classified as retention cysts. It has not infrequently been observed that after the removal of the choriomatous growth, the lutein cysts have spontaneously disappeared.

## TUMORS OF THE OVARY

No organ of the body has so great a disposition to tumor, especially cyst formation, as has the ovary, as would be expected from the natural characteristics of its tissues. The enormous proliferating power of germinal epithelium, the physiologic process of atresia and cyst formation, the monthly congestion, and the secretory power of the epithelial structures are all normal forces which it may well be imagined are readily transformed from physiologic functions to pathologic processes.

**Ovarian Epithelium.**—A proper understanding of the ovarian epithelium necessitates a brief review of the embryonic origin of the internal genital structures. In early fetal life the Wolffian bodies, developing from a fold of the mesoderm, appear as two large sausage-shaped bodies lying longitudinally, one on each side of the dorsal cord and at their fullest development constituting the most prominent structures of the fetal abdomen. Each body is made up of a large number of small tubules, running transversely and emptying into a longitudinal canal, the so-called Wolffian duct, the whole arrangement being similar to that of a comb. The free end of each tube terminates in a vascular knot or glomerulus. After having reached its climax of growth the Wolffian tubules numbering 83 on each side begin to atrophy until in the male only about 12 remain, which through the medium of the glomeruli become connected with the seminiferous tubules of the testicle and thus form the system of canals known as the epididymis and vas deferens. In the female all the tubules of the Wolffian body, including the duct, atrophy, the whole apparatus becoming a functionless vestigium represented by such structures as the parovarium and Gärtner's duct. There is, to be sure, some attempt at union between the glomeruli and the ends of the sex cords in the hilus of the ovary, but there is no luminated connection between the two structures; nor, according to the best recent authorities, is there any invasion of the Wolffian tubules into the ovary, a point which is of importance in determining the histogenesis of the ovarian cystomas. In other words, embryologic study rules out the possibility of finding in later life rests of Wolffian epithelium in the ovarian substance.

Just inside the two huge Wolffian bodies and running parallel with them there appear at the same time two other smaller folds of peritoneum, called the genital ridges, from which are developed the sex glands (ovaries or testes). The evolution of the ovary or testis from the primitive fold in the peritoneum is somewhat complicated, but in order to avoid confusion and to impress certain points that are of later clinical importance, we shall endeavor to describe the process in the simplest terms.

The epithelium of the peritoneum of the genital fold undergoes at first a localized multiplication of its cells, the primary result of which is to cause the cells, which have hitherto lain flat like the stones of a pavement, to heap up on edge, as it were, in the manner of a row of bricks. The cells then assume the characteristic appearance seen on the surface of the adult ovary, and are designated the *germinal epithelium.*

The germinal epithelium immediately reveals a tendency to invade the loose subjacent connective tissue upon which it is ensconced. The down-growing cells as they proliferate from the germinal layer become segregated by the connective-tissue fibrils into more or less

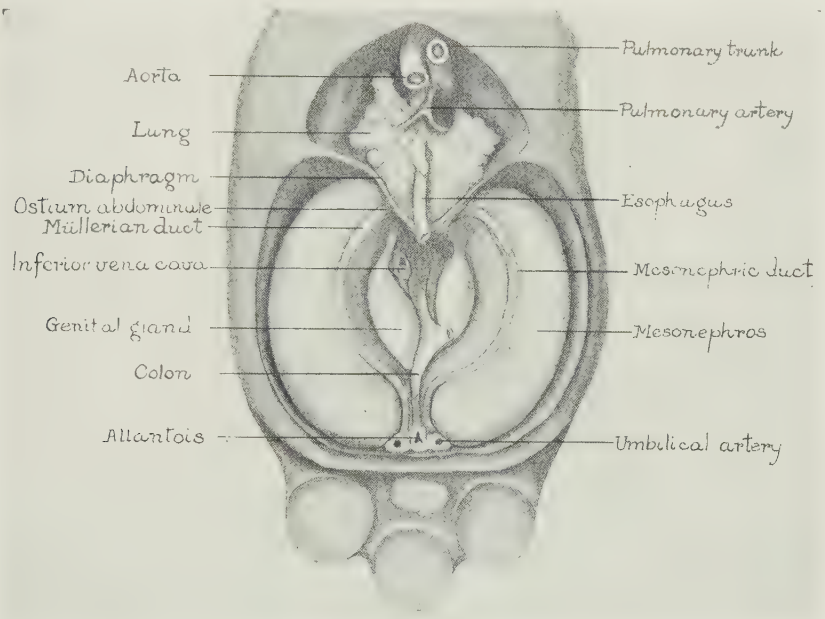


Fig. 142.—Drawing from Young Embryo Showing Relationship of the Mesonephros and Genital Glands.

well-defined columns, which converge toward the hilus of the gland. During a certain period the gland remains indifferent, that is to say, there is no distinctive appearance in its structure by which the ultimate sex may be foretold. When sexual differentiation does take place, the sex cords of the male gland become luminated, and form a conjunction with the surviving twelve tubules of the Wolffian body through the medium of their terminal Malphigian corpuscles. Thus the testis becomes a true organ of external secretion, by which the spermatozoa, elaborated in the gland, are discharged through the seminiferous tubules (sex cords) and the epididymis (Wolffian tubules) into the vas deferens (Wolffian duct), and thence into the outlet of the urinary canal.

It is interesting to note that when the sex gland becomes *male* the germinal epithelium ceases its invasion, and, flattening out, becomes from that time on throughout the life of the individual merely an inactive, epithelial sheath to the organ.

The ovary, on the other hand, at the time of sex differentiation passes through a very different evolutionary process. The sex cords, which in the male organ develop into seminif-

erous tubules, atrophy and disappear if the organ becomes female, leaving only faint vestigia. Moreover, the germinal epithelium, instead of flattening out as in the male, becomes reactivated and continues to make new invasions of its proliferating cells into the substance of the gland.

The life-history and fate of these invading cells now presents a picture of great interest. Certain cells in the germinal epithelial layer and in the invading columns become larger and paler than the other cells, the nuclei becoming large and transparent. These cells, derived by a process of differentiation from the germinal epithelium, are called *primordial ova*, and are the original egg-cells, some of which eventually become true ova. At the inner ends of the cords, *i. e.*, the ends toward the hilus, there is from the earliest invasion a tendency of

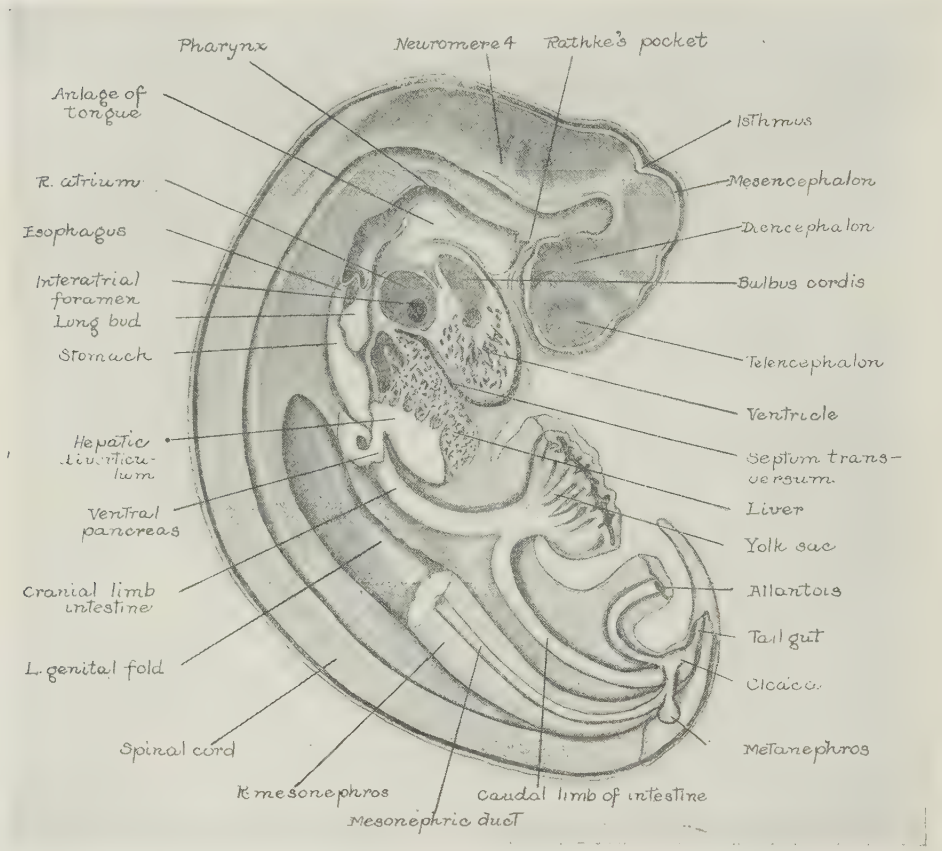


Fig. 143.—Longitudinal Section of Embryo to Show Especially the Relationship of the Mesonephros and Genital Fold.

The mesonephros is represented as broken off in the middle in order to show the genital fold.

the connective tissue to cut off portions into segregated masses of cells in which the smaller cells attempt more or less successfully to surround by a single layer the large primordial ova. A primordial ovum cell thus surrounded by a ring of smaller cells constitutes a primordial follicle, the encircling cells representing the early stage of the granulosa layer of epithelium which lines the fully developed follicles.

The tendency thus described appears in the first invasions of the germinal epithelium during the indifferent stage of the gland, but is incomplete. The early primordial ova and follicles for the most part degenerate. It is not until the sex of the gland has been established and the male characters atrophied and out of the way that the primordial elements of the

new invasion of germinal epithelium become formed as true ova and Graafian follicles. The whole energy of the ovarian function is now devoted to the nourishment and development of the egg-cells. They are scattered in large numbers through the entire mass of invading

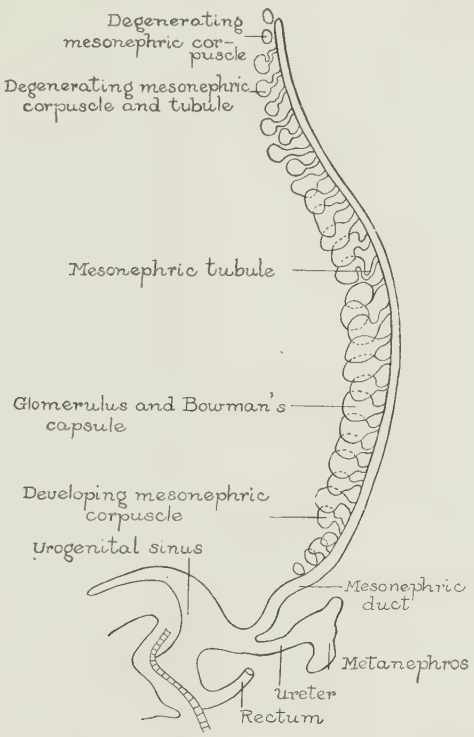


FIG. 144.—DIAGRAM SHOWING THE CONSTRUCTION OF THE MESONEPHROS.

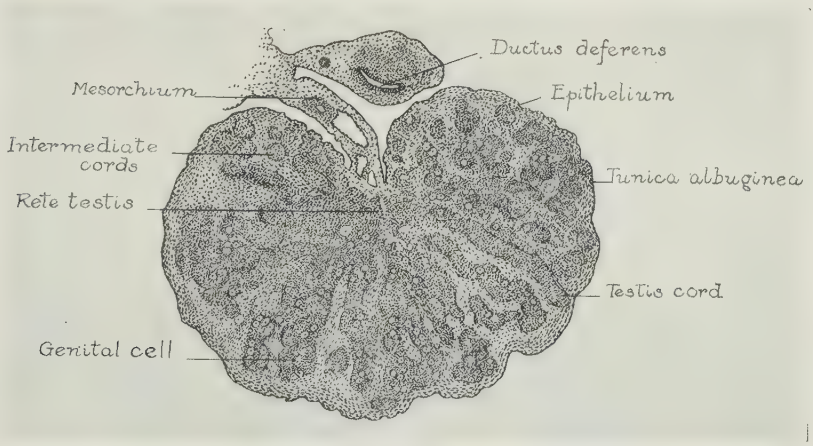


FIG. 145.—SECTION OF TESTIS SHOWING SEX CORDS.

cells. Out of all the great multitude of these primordial egg-cells only a few are elected to become true ova and attain the dignity of follicular inclusion by the small indifferent cells whose office it is thenceforth to serve as nourishers to their more exalted relatives.

It seems quite evident that there is a sort of emulation on the part of the primordial egg-

cells to become ova. Sometimes several coalesce into a syncytial mass, with nuclei corresponding to the number of united cells, in which case one cell survives at the expense of the others, by a sort of cannibalism, as Lane-Claypon expresses it. The great majority of the unsuccessful primordial ova reach a certain climax of prefollicular growth and then retrogress, their final destiny being that of the interstitial cells, in which capacity they play a most important rôle. Thus they surround the Graafian follicles in the form of the theca interna and probably furnish the chief elements of the cells of the corpus luteum. They compose a considerable portion of the ovarian stroma and are probably the main source of the ovarian internal secretion.

Just what determines the fate of a particular cell in becoming a full-fledged ovum is a matter of speculation. Quite likely it is due partly to a native ruggedness of the cell itself which enables it to survive at the expense of neighboring cells, and partly to the circulatory environment in which such a cell happens to be placed. This latter theory is supported by the observation that the development of primary ova with follicle formation is more vigorous in the intensely vascular medullary area than in the region of the cortex.

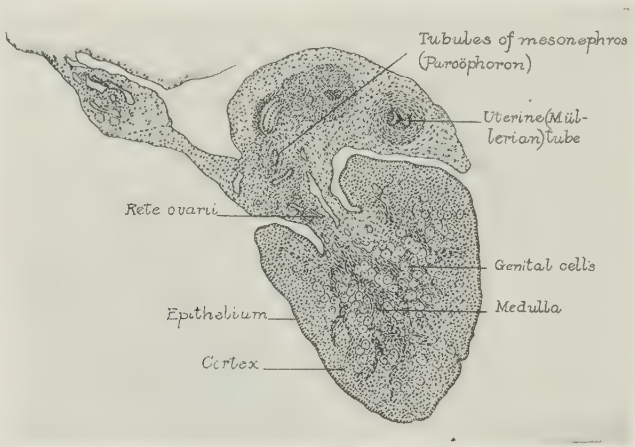


Fig. 146.—Section of Ovary Showing Germinal Epithelium, and Genital Cells. The cord-like form of invasion has become indistinct.

To recapitulate, then, the ultimate destiny of the individual cells of the germinal epithelium seems to be founded on a well-organized economic plan. Though all the cells originate from a common type of epithelium, some attain a greater or less pre-eminence as ova, while others, remaining as indifferent cells, finish their existence in protecting and nourishing the ova. Still others after achieving a certain degree of distinction as primitive ova, become interstitial cells and functionate for the common good in elaborating an internal secretion, and probably also in aiding the nourishment of the corpora lutea and atretic follicles.

## CLASSIFICATION OF OVARIAN TUMORS

No entirely satisfactory classification of ovarian tumors has yet been made. Most of those that have been offered are either too simple or too complicated for practical purposes; others are scientifically inconsistent in their basis of classification. The earliest division into solid and cystic tumors, based on gross appearance only, was made before the knowledge of microscopic histology, and is obviously inadequate. Waldeyer was the first to separate ovarian tumors into those derived from an epithelial and those from a connective-tissue origin. Of the various classifications based on this principle that of Pfannenstiel is the

most practical. We shall in general follow him, with certain modifications necessary in the light of more recent knowledge of the histology of the ovary.

Tumors of the ovary may be divided into two main groups: (1) the non-proliferating and (2) the proliferating. Non-proliferating tumors, though representing physiologic processes of the ovary, must nevertheless be regarded as tumors, for they are susceptible to pathologic circulatory changes and are sources of danger to the patient. The proliferating tumors are divided into (1) those that originate from the germinal epithelium and its various derivatives; and (2) those that develop from the true ovarian stroma—the first group being distinguished as parenchymatous and the second as stromatogenous. The parenchymatous elements, as we have seen, comprise the germinal epithelium, and granulosa cells of the follicles, the vestigial remains of the rete and medullary cords, and the ova. The ovarian stroma, formerly supposed to consist entirely of essential connective tissue, must, in the light of more recent knowledge, be regarded as having a twofold composition, *i. e.*, interstitial cells, and the supporting connective-tissue framework. As it has been shown that the interstitial cells are as truly derived from the germinal epithelium as the granulosa and ova, they must, therefore, be subtracted from the stroma and included in the parenchyma. Certain tumors formerly classified as stromatogenous will therefore be transferred to the parenchymatous group. This change in our conception of the structure of the ovary creates a certain amount of confusion in the use of the word "stroma." From a strictly scientific standpoint, as pointed out by Goodall, the true stroma of the ovary relates only to the supporting framework and the accompanying blood-vessels. The following modified classification based on that of Pfannenstiel is offered. It will at once be noted that it contains certain inconsistencies. The classification is primarily histogenetic in purpose, but in making certain necessary subdivisions it is impossible not to deviate from this principle. Thus, in dividing the important group of cystadenomata into pseudomucinous and serous varieties, we are using the contents of the cysts as the basis for the subdivision. This is unavoidable because we do not know surely the histogenesis of the pseudomucinous cysts. Even if we agree with Goodall, that both varieties originate from the germinal epithelium, it is still necessary to divide them on a clinical basis on account of the very great difference that exists between them in their clinical courses, pathologic development, and surgical requirements. The histogenesis only of the serous cystadenomata and the purely stromatogenous tumors have been unequivocably established. The other inherent ovarian tumors, though probably coming from the germinal epithelium as their ultimate source, cannot be classified with scientific consistency until we know in which group of the highly differentiated derivatives of the germinal epithelium each type of tumor has its direct origin.

The present classification must therefore be accepted as the best that we can offer under the circumstances. It is selected and modified with a clear view as to its practical usefulness to the clinical gynecologist.

Pfannenstiel's original classification comprised under the heading of proliferating tumors the parenchymatous and stromatogenous groups. Since the epochal work of Sampson on the endometrial hemorrhagic (chocolate) cysts it is necessary to add a third group, which we shall take the liberty of designating as Implantation Tumors. We do this on the basis of Sampson's theory of the origin of chocolate cysts, *i. e.*, that they evolve from implants of the endometrium in the ovarian substance. This provisional theory we accept as in all probability true, and, as we have stated in the section on cancer of the uterine body, have adopted it as an explanation of the appearance in the ovaries of metastases from the primary endometrial cancer. We shall therefore include in this group the ovarian tumors secondary to cancer of the uterine body. Into this new group may conveniently be included, also, the ovarian cancers secondary to malignant growths of the intestinal tract, which, as we shall see, are undoubtly due to implantation metastases.

TUMORS OF THE OVARY

A. Non-proliferating:
    1. Follicle cysts.
        (Theca lutein cysts.)
    2. Corpus luteum cysts.
B. Proliferating:
    I. Parenchymatous tumors:
        1. Pseudo-mucinous cystadenomata.
        2. Serous-cystadenomata.
        3. Carcinomata:
            (*a*) Solid.
            (*b*) Cystic.
        4. Ovigenous tumors:
            (*a*) Dermoids.
            (*b*) Teratomata.
        5. Interstitial cell tumors.
        6. Implantation tumors:
            (*A*) Endometrial hemorrhagic (chocolate) cysts.
            (*B*) Secondary carcinomata, from
                (*a*) Adeno-carcinoma of endometrium.
                (*b*) Carcinoma of intestinal tract.
    II. Stromatogenous tumors:
        1. Fibromata.
        2. Fibromyomata.
        3. Sarcomata.
        4. Peritheliomata and endotheliomata.

### (1) Non-proliferating Tumors

The tumors of this group represent errors in the development and regression of the Graafian follicles which result in retention cysts. These cysts are of two kinds—those which are produced by abnormal secretion of an atretic follicle, *follicle cysts*, and those which are consequent on incomplete involution of a corpus luteum.

**Follicle Cysts.**—We have seen in the section on Physiology that only a comparatively few of the primary follicles with which the ovary is originally endowed

come to full maturity. Most of the follicles during some stage of their development become aborted; the ovulum dies; the epithelium of the membranosa

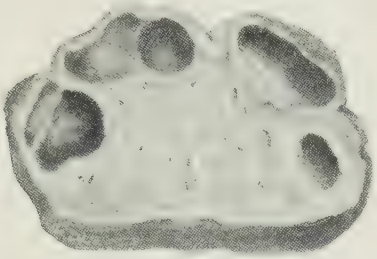

FIG. 147.—CYSTIC DEGENERATION OF THE OVARY.

Macroscopic drawing of a section of a whole ovary. In the cortex are several small cysts which microscopically proved to be cysts of Graafian follicles. On the left are cysts with only thin partitions between them, suggesting how, as they become larger, the partition thins out, ruptures, and allows two cysts to coalesce into one.

FIG. 148.—CYST OF A GRAAFIAN FOLLICLE.

Low power. At the top is the lining of the cyst consisting of one to several layers of cells derived from the membrana granulosa of the follicle. This lies on the connective-tissue stroma of the ovary. Through the center of the section are several Graafian follicles, the cells of which have fallen out in cutting the section. The lower part of the section is the cortex of the ovary, the epithelial covering being absent.

degenerates and disappears. This process is termed *atresia of the follicle,* and is, in a certain sense, physiologic. Atresia of a follicle is attended with a certain amount of secretion, especially when the lining epithelium (granulosa) persists,

so that many of the follicles become visible cysts of greater or less dimensions. This cyst formation is, within certain limits, to be regarded as a physiologic process. Under certain conditions, however, the production of these cysts becomes abnormally great, and the ovary is then said to be in a state of *cystic degeneration*, though the line between the normal and abnormal state is not clearly defined. Just what causes cystic degeneration is a matter of some doubt. Increased density of the connective-tissue stroma (interstitial oöphoritis), which prevents proper resorption of the atretic follicle elements, probably

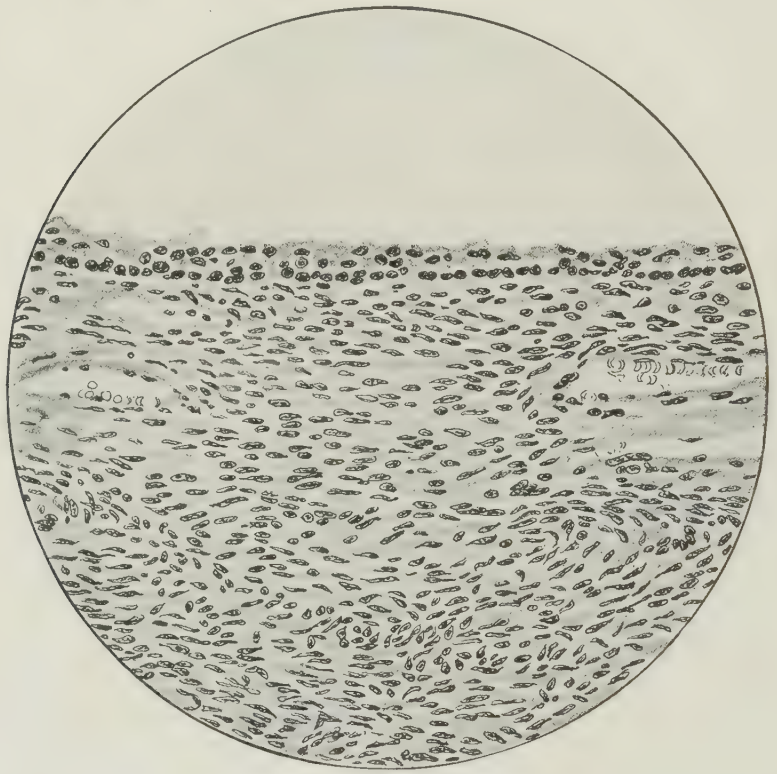

FIG. 149.—CYST OF A GRAAFIAN FOLLICLE.

High power. At the top is the lining of the cyst wall, consisting of layers of cells derived from the membrana granulosa of the follicle. Below this is the loose connective tissue that surrounds the follicle, and below this the dense connective tissue of the cortex of the ovary.

acts as a cause in a certain number of cases. In other instances it is likely that disturbances of circulation, such as repeated or continuous hyperemia, may cause a too rapid development of the primordial follicles and hence an overproduction of atretic follicles.

An example of the evidently physiologic function of follicle atresia is seen in the ovaries of pregnancy, in which the process is so marked as to suggest some internal secretory influence on the part of the trophoblastic tissue of the embryo. During active follicle atresia the cells of the theca interna become enlarged

and assume lutein characteristics, and are, therefore, designated as theca lutein cells. It seems probable that the theca lutein cells produce an internal secretion, or, rather perhaps, that they intensify the normal ovarian output, since preparations from ovaries of pregnant animals are especially efficacious in ovarian therapy.

Cystic degeneration causes a general enlargement of the ovary, but it does not reach the dignity of a tumor until one of the cysts grows at the expense of the other cysts and the rest of the ovarian tissue.

The growth of an atretic follicle cyst may be due to persistence of the lining

FIG. 150.—CORPUS LUTEUM CYST OF OVARY.

Macroscopic drawing, enlarged, of section of whole ovary. On the right is a corpus luteum showing well the plicated envelope of lutein cells. The cavity was filled with cloudy fluid, as in this case the blood did not organize and we have an early stage of corpus luteum cyst. On the left are several corpora lutea which have gone on to the stage of corpus albicans, and at the top one small corpus luteum still in process of organization.

epithelium which continues to secrete a clear amber fluid (v. Franque). Usually, however, the membrana granulosa disintegrates and disappears. The growth of the cyst is then conditioned on a transudation from the blood-vessels of the theca interna, which may persist for a long time.

As a rule, only one cyst takes on this abnormal growth, though sometimes there may be two and even three. As the cyst continues slowly to enlarge, the rest of the ovarian tissue, including the other follicle cysts, becomes compressed, so that finally it becomes stretched out and incorporated in the thin wall of the usurping cyst, appearing only as a whitish, opaque thickening of the wall.

The great majority of follicle retention cysts reach a fairly uniform size, about that of the fist. They have a thin translucent wall, usually with no sign of epithelial lining. Most of them are monolocular.

Some of the follicle cysts grow to a much larger size, even to that of a man's head. The larger cysts are lined with epithelium, and the greater size of the cyst is due to active secretion on the part of the lining epithelium. Follicle cysts of this type cannot, therefore, be regarded properly as retention cysts.

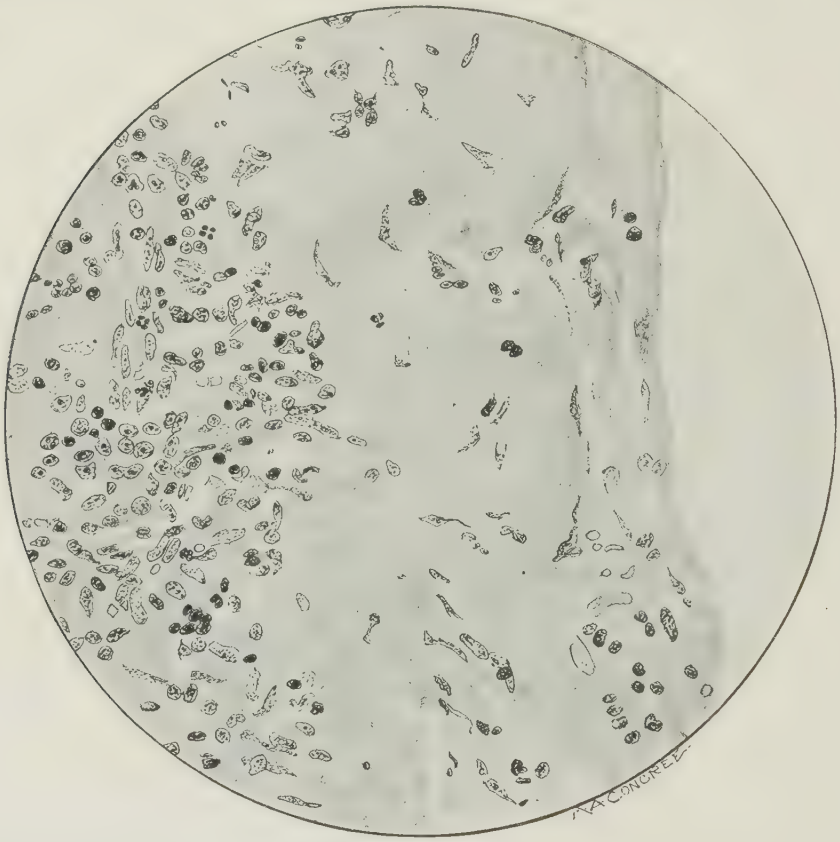

Fig. 151.—Corpus Luteum Cyst.

High power. To the right is the cavity of the cyst. Lining this is seen a thin layer of connective tissue. A line of demarcation can be seen between this layer and the next which consists of fibrous tissue rather more dense, which has taken the place of the layers of lutein cells. On the left is the connective-tissue stroma of the ovary with a few round cells in it.

There is also a question whether they should be included as non-proliferating tumors. Von Franque does not consider the persistence and increase of the epithelial lining structure sufficient cause to include them in the new-growth tumors, and points to a similar growth of tubal epithelium in the large hydrosalpinges.

Follicle cysts are essentially benign and have almost no tendency to papillary outgrowth. Occasionally wart-like excrescences are found on the inner

surface, but these, as a rule, represent only local hyperplasia of the connective tissue rather than an overgrowth of epithelium.

**Corpus luteum cysts** differ from follicle cysts in that they represent a cystic formation that takes place in a more advanced stage of development of the follicle. They attain about the same dimensions as the follicle cysts. They are recognizable in the earlier stages by the wavy, characteristically yellow lutein-cell lining. The cyst content is usually of a reddish, turbid character, in distinction from the clear amber fluid of the follicle cysts. In the large corpus luteum cysts epithelial elements may be entirely wanting, so that they cannot be identified from follicle cysts even by microscopic examination.

Blood-cysts of the ovary may result from the internal bleeding of follicle or corpus luteum cysts. According to von Franque, hemorrhages may occur in the ovarian stroma in cases of chronic oöphoritis which causes a special frangibility of the blood-vessels. Such hemorrhages take place at the menstrual periods, and repeated hemorrhages at consecutive menstruations may cause blood-cysts of considerable size. The fresh outflow of blood may produce severe pain and serious symptoms, even death. On rare occasions a follicle blood-cyst may rupture, causing a dangerous abdominal hemorrhage. The symptoms resemble those of a ruptured ectopic pregnancy, and may demand immediate operation. As a rule, however, the condition is not a serious one, and the discharged blood is gradually resorbed. Doubtless some of the puzzling cases in which an ovarian cyst is unmistakably felt by vaginal examination, only to disappear completely in a comparatively short time, are instances of blood-cysts. True cysts, unless they rupture, do not disappear in this way.

*Important Note.*—The foregoing paragraph occurring in the first and second edition of this book is purposely left in the third edition to indicate the status of our knowledge of these tumors before the appearance of Sampson's work on the perforating hemorrhagic or chocolate cysts of the ovary. It is quite possible that occasionally blood-cysts like those described above may result from the internal bleeding of a retention cyst. The typical "menstruating cysts," however, must be included under the heading of chocolate cysts, and should be regarded as true neoplasms rather than as retention cysts.

To the non-proliferating cysts of the ovary is given the name *cystoma*, or cystoma simplex. This term implies a simple cystic enlargement of the ovary, and must be distinguished from the word *cystadenoma*, which is applied to the true proliferating cysts.

In addition to the corpus luteum cysts are other cysts, called *theca-lutein cysts*. The theca-lutein cysts develop from atretic follicles, but the cells of the theca interna (connective tissue) become hypertrophied and form a layer on the inside of the follicle which looks much like the lutein layer of the true corpus luteum. The layer, however, is not as wavy and folded, nor are the cells as large and well marked, as the true lutein cells. To distinguish them they are called *theca-lutein* cells. Isolated remnants of these theca-lutein cells

found in the ovaries constitute the so-called interstitial gland, which it is thought may play some part in the production of the ovarian internal secretion.

It is not always possible to distinguish between a corpus luteum cyst and a theca-lutein cyst unless the yellow layer lining the cyst is markedly folded and the cells large and unmistakable. The theca-lutein cysts may contain hematomata, and they may become infected from the tube in the same ways as the corpus luteum cysts.

The theca-lutein cysts are especially in evidence in association with hydatid mole or a chorio-epithelioma. It is estimated that in more than 50 per cent. of cases of mole the ovary undergoes a cystic degeneration, which disappears after the removal of the mole. These cystic ovaries have been shown to contain theca-lutein cysts. They are about the size of an apple and usually multiple. They are lined with a lutein layer, which, however, is flatter and thinner than that of a true corpus luteum. They do not have much clinical significance, as they usually regress if the patient does not die from the disease of the placenta.

There has been some debate as to whether the cystic condition of the ovary is the result or the cause of the degenerative processes of the chorion seen in hydatid mole and chorio-epithelioma. It seems likely that the cysts represent an excess in the process of atresia of the follicles that normally takes place during pregnancy. (See also chorio-epithelioma, last section.)

It is important to bear in mind the possibility of the occurrence of these cysts with mole or chorio-epithelioma, for otherwise their discovery might lead to the diagnosis of metastases from the original disease.

### (2) Proliferating Tumors of the Ovary

The proliferating tumors represent neoplastic growths from the ovarian tissue, and are divided into two classes, according to whether they develop from the epithelial (parenchymatous) elements or whether they arise from the connective-tissue (stromatogenous) structure.

**Parenchymatous Tumors.**—About 80 per cent. of all new growths of the ovary have a glandular or adenomatous character, of which by far the greater number exhibit secretory activity on the part of the epithelial cells that line the glandular structures. The term *cystadenoma* is, therefore, given to these tumors to indicate the pathologic process that underlies their growth. The glandular proliferation takes place from the epithelial cells that line the original cyst, and is represented by the formation of daughter cysts, which in turn reproduce themselves in the same way until innumerable cysts are formed. In this way the main tumor is made up of many cystic chambers, and is, therefore, called *multilocular*. All cystadenomata are essentially multilocular.

It may, however, happen that one or a few cysts grow at the expense of the others which become compressed into the surrounding wall, or many small cysts may rupture and become confluent into one larger cyst, so that the tumor may have the appearance of a single cyst (monolocular) or there may be only

a few chambers apparent (parvilocular). Microscopic examination of the walls of such tumors reveals their true multilocular nature. The epithelium of cyst adenomata, in addition to its power of producing daughter-cysts, is prone to sprout forth into papillary branches. This usually takes place toward the lumen of the cyst, in which case the growth is said to be "inverting." The papillæ may also grow outwardly and appear as excrescences on the outer surface of the main tumor, in which case they are termed "everting." The epithelium from these tumors, when broken off from the papillary excrescences of the outer wall, or when it escapes from the cyst lumen through a rupture of the wall, has the power of becoming implanted in the tissue on which it falls and of reproducing both the glandular cystic and the papillary processes that it de-

Fig. 152.—Pseudomucinous Cystadenoma of Ovary (Papillary).

velops in the main tumor. These extraneous growths are called *seed* or *implantation* metastases. They are most commonly seen on the peritoneum of the abdominal viscera and parietes.

The cystadenomata of the ovary are of two types which differ markedly from each other in their contents, histologic structure, and tendency to papillary and malignant proliferation. They are named, from the character of their contents, "cystadenoma pseudomucinosum" and "cystadenoma serosum."

The *pseudomucinous cystadenomata* are said to constitute the commonest form of ovarian tumors, though in our own series of cases they have been found less frequently than have the serous cystadenomata. They are usually *unilateral*, and rarely develop between the leaves of the broad ligament, tending rather to have well-formed pedicles. These cysts are oval in shape, with a smooth sur-

face. They are always *multilocular*, and are distinctly glandular in type. The single chambers of the tumor vary greatly in size, usually a few of them growing to considerable proportions at the expense of the others. The fluid contents consist of a thick mucoid substance, which resembles closely true mucus in appearance, but differs from it in that it does not present the characteristic mucin reaction with acetic acid; hence its name, "pseudomucin."

The color of the pseudomucin, which in its pure state is of a clear glassy transparency, may be considerably altered by transudations from the blood-vessels and by necrotic changes in the cyst wall, from torsion, so that it may present numerous tints, from yellowish or greenish-gray tones to dirty brown

Fig. 153.—Multilocular Cyst. Adenoma of the Ovary with Superficial Fibroma. (Low power.)

or even black. Often a characteristic greenish, shimmering hue is seen, due to the presence of cholesterin plates, which represent a product of regressive changes in the cellular elements (von Franque). The reaction is alkaline.

The cysts are lined with a high, non-ciliated, cylindric epithelium with a basal nucleus. During activity these epithelial cells assume the characteristic appearance of beaker cells, and secrete pseudomucin in the same way as the lining cells of the stomach or gall-bladder secrete true mucus. The cells are beautifully arranged in regular order in a single layer. As distinguished from the serous cystadenomata, papillary outgrowth of the lining epithelium is comparatively rare.

From a clinical standpoint, the pseudomucinous cysts belong to the class of benign neoplasms. They grow very slowly and may reach enormous dimen-

sions. The famous classical ovarian tumors of great size that were frequently described before the days of modern surgery were of this type.[1] They rarely develop carcinomatous degeneration, in which they are again distinguished from the serous variety, which has an especial tendency to malignancy.

From an operative standpoint the pseudomucinous cysts are particularly favorable. The operation itself is usually attended with little difficulty, because, having no inclination to grow between the leaves of the broad ligament, they usually lie free in the abdomen, with an easily accessible pedicle. Adhesions to the intestines are not present unless the tumor is complicated by some inflammatory process, such as might ensue from salpingitis or from torsion of the pedicle. Inasmuch as the disease is usually confined to one side, and as

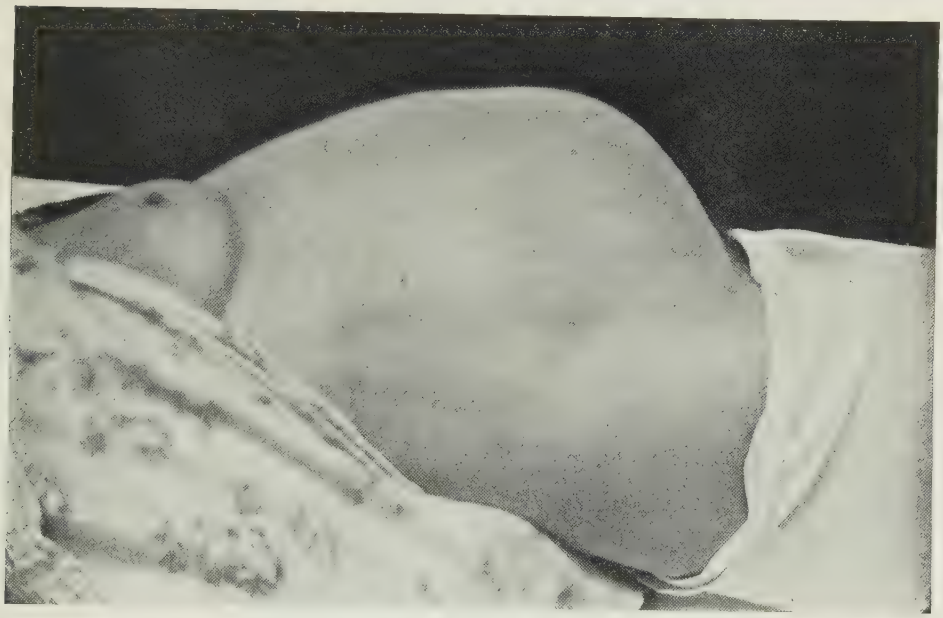

FIG. 154.—CONTOUR OF ABDOMEN CONTAINING A LARGE OVARIAN CYST.
(Reproduced from a photograph.)

there is little tendency to later recurrence in the unaffected ovary, a simple extirpation of the tumor, without removal of the other organs of the pelvis, is all that is necessary. It should be remembered, however, that carcinomatous degeneration, though rare, is still possible, and the rule of making a careful gross examination of the growth before closing the abdomen should always be carried out, as in the removal of all ovarian neoplasms. If carcinoma is discovered, the uterus and other ovary should be removed. According to Pfannenstiel, carcinomatous recurrences have taken place in the scar of the stump from which the tumor has been removed. This complication, however, must be so rare that it need not be taken into very serious consideration.

[1] Dr. J. W. Ward of San Francisco has recently reported the removal of a mammoth tumor of the pseudomucinous type weighing 221 pounds and 12 ounces. He has made a careful review of the literature and finds that the largest reported tumors have occurred in the last twenty years. He cites Spohn's case of 328 pounds, which is apparently the largest ovarian cystadenoma on record.

The spilling of the cyst contents in the abdominal cavity is attended with less risk than in the case of serous cystadenomata, as the epithelial elements have less tendency to implant themselves on the peritoneum. This, however, is not universally true, for it occasionally happens that cell elements that have escaped from the cyst into the peritoneal cavity, either spontaneously or from accidental rupture during operation, form implantation metastases, which, by the peristaltic movements of the intestine, may become disseminated throughout the abdomen. The cells continue to secrete pseudomucin, so that as a

FIG. 155.—PAPILLARY CYSTADENOMA OF THE OVARY.

Low power. The papillary projections from the wall of the cyst can be seen cut in various planes. They consist of a connective-tissue stroma containing blood-vessels, covered with a single layer of cylindric epithelium.

result the entire peritoneal cavity becomes filled with extensive gelatinous masses that cannot easily be removed. This condition has been described by Werth, and named by him *pseudomyxoma peritonei*. The process, though essentially benign, has, nevertheless, a bad prognosis, for the gelatinous masses, acting on the peritoneum as a foreign body, cause a form of chronic peritonitis which usually eventuates in the death of the patient. Life may be prolonged by repeated laparotomies and removal of as much of the growth as possible.

On the other hand, it occasionally happens that after the removal of the greater part of the masses the remainder disappear spontaneously.

*Cystadenoma Serosum.*—The serous cystadenomata, like those of the pseudomucinous variety, are usually multilocular, though the number of chambers is much less than in the former. Many times they appear macroscopically monolocular, but microscopic evidence of daughter-cysts may be found in the wall. These tumors are characterized by being filled with a clear, yellowish, serous fluid, entirely free from pseudomucin and extremely rich in albumin. The cysts are lined with a low-cylinder epithelium, which is *usually* ciliated, and

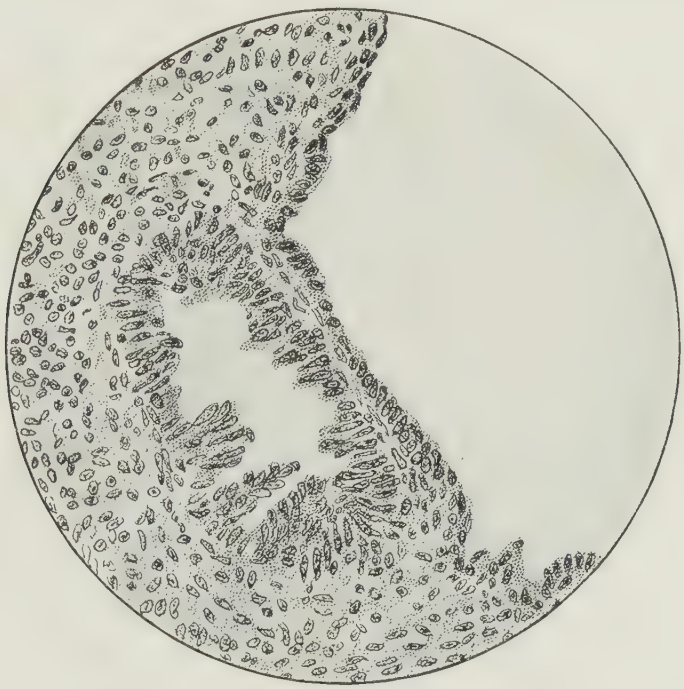

FIG. 156.—PAPILLARY CYSTADENOMA OF THE OVARY.
High power to show an early stage in the papillary formation. In the gland on the left can be seen tufts of epithelium growing out into the cavity of the cyst.

which closely resembles in size and form the epithelium of the uterine and tubal mucosa. Most of the serous cystadenomata show a papillary proliferation of the lining epithelium.

The papillary process may appear both in the inner lining of the cyst and on the outer surface. In both cases the histologic appearance of the epithelial cells is the same, namely, that of a low, cylinder-ciliated epithelium, though the cilia are apt to be wanting in exposed portions of the outer papillary growths and if they become carcinomatous.

The serous cystadenomata, in contrast to the pseudomucinous, have a tendency to grow in both ovaries, *although the process may not be contemporaneous in*

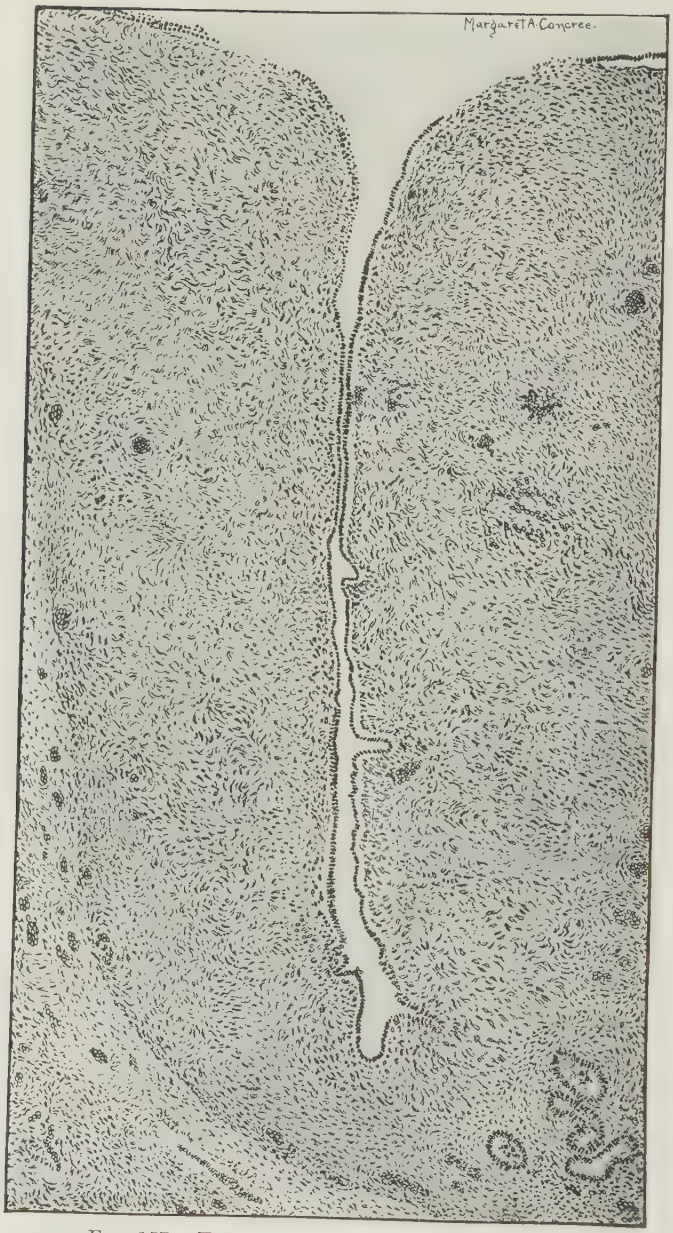


Fig. 157.—Epithelial Inclusion in the Ovary.

Low power. This drawing illustrates one method of the formation of a cystadenoma. A deep sulcus is seen in the cortex of the ovary, which is lined by the epithelium peculiar to the ovary. At the bottom to the right are seen several gland-like formations, the epithelium of which is higher and in process of proliferation. These glands may be formed by the end of such a sulcus being pinched off. Then if proliferation takes place a cystadenoma may be formed. To the left the line of demarcation between the cortex and the rest of the ovarian stroma is well shown.

*the two*, a fact that must always be borne in mind by the surgeon. Another unfavorable characteristic which the serous cystadenomata possess in com-

parison with the pseudomucinous is that they are apt not to be supplied with good pedicles, but have a tendency to develop through the hilus of the ovary between the leaves of the broad ligament. In this confined position they not only cause more symptoms of pain and pressure, but are more difficult and dangerous to remove. The serous cystadenomata grow more slowly than the pseudomucinous type and do not reach as large a size.

The clinical significance of serous cysts depends very much on whether or not they are papillomatous. The non-papillary variety is usually benign and does not recur after operation, but it is possible that an apparently non-papillary

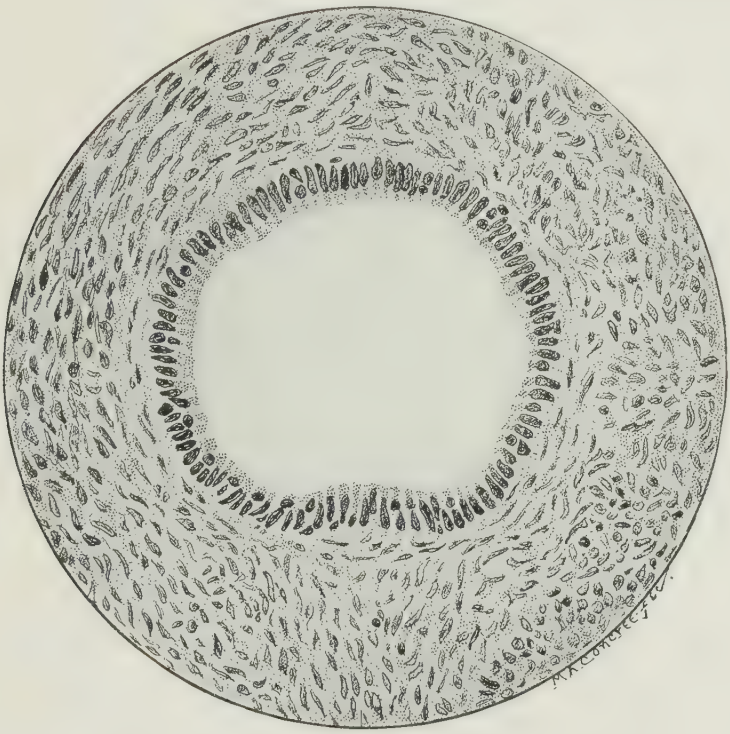

Fig. 158.—Epithelial Inclusion in the Ovary.
High power. A gland-like formation found in the cortex of an ovary which may be the beginning of a cystadenoma of the ovary.

cystoma may recur rapidly in cancerous form, the papillary growth having existed microscopically in the wall of the original tumor.

The papillary tumors are of more serious clinical importance because of their greater tendency to malignant degeneration, and because of the possibility of implantation papillomata on the peritoneum. This results always in an ascites that may become prodigious.

It sometimes happens that after removal of the main cyst the seed papillomata of the peritoneum spontaneously disappear. In other cases they remain and the ascites rapidly reappears.

The origin of the ovarian cystadenomata is a subject of much interest. It was formerly thought that these tumors are derived from isolated rests of the Wolffian or Müller's ducts which are sometimes found in the ovary. This theory seems unlikely, because the above-named rests do not produce like tumors in locations other than the ovary.

It has been established beyond doubt that the serous papillary cystadenomata spring from the germinal epithelium covering the ovary. They may develop from papillary outgrowths from the ovarian surface, or from gland-

Fig. 159.—Epithelial Inclusion in the Ovary.

Low power. This illustrates a possible beginning of a cystadenoma. In this case an adhesion to the ovary caused the formation of the cavities seen. The epithelial cells have already lost the low cuboidal shape of the normal ovarian epithelium and are proliferating, as is seen in the next drawing.

like inclusions that result from a dipping-in of the epithelium into the substance of the ovary.

It has been the fortune of the author to secure from an operation performed for pelvic inflammation a specimen of very early papillary serous cystadenoma involving both ovaries, in which it is clearly evident that the growth in both ovaries is developing from the germinal epithelium, both from the surface and from inclusions in the stroma. (See Figs. 161, 162.)

The origin of the pseudomucinous cysts is not as well established as that

of the serous type, but there is good evidence to show that these tumors also spring from the germinal epithelium.

The exciting cause of tumor formation in the ovaries is not known. Inflammatory processes seem to have no particular relation to their development. They may appear at any period of life, even in fetal life. It seems probable that the *anlage* from which the cystadenomata are derived dates back to abnormal embryonal development, by which cell inclusions of the germinal epithelium are left in the ovary that are capable of lighting up into activity at any

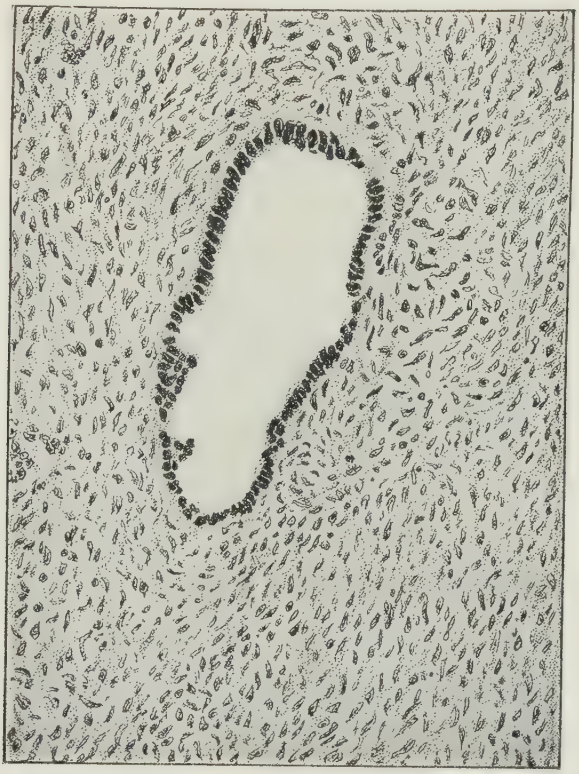

FIG. 160.—EPITHELIAL INCLUSION IN THE OVARY.
High power from the previous drawing. The cells lining the cavity have become higher and have larger nuclei than the normal ovarian epithelium.

period of life. There is a question as to whether inflammatory processes predispose to cyst formation of the ovary. Pfannenstiel believes that the influence of inflammation is important, especially in malignant papillary tumors. von Franque, on the other hand, regards inflammation as a negligible factor.

**Carcinoma of the Ovaries.**—Gebbard divides carcinoma of the ovary into two classes—(*a*) Genuine, idiopathic carcinoma, which develops directly from previously unchanged ovarian tissue, and (*b*) cystic carcinoma, which either develops from a benign ovarian cyst (carcinomatous degeneration) or starts as a cancerous cyst from the first.

(*a*) The *solid*, or genuine, carcinomata of the ovary are very rare, and are usually of the medullary type. They do not grow to a very large size. The consistency of these tumors is soft, white, and brain-like, and they have an especial tendency to various kinds of degeneration, so that cyst formation is often found. Microscopically, the medullary cancers often show a tendency to adenomatous growth. These cancers become dangerous when they have broken through the outer capsule, in which case the disease is disseminated throughout the abdominal cavity.

(*b*) *Cystic Carcinoma.*—The cystic carcinomata may start as malignant tumors, or they may represent a carcinomatous degeneration of a benign papil-

Fig. 161.—Bilateral Papillary Cystadenoma of the Ovary.

Drawing from a specimen removed at operation by the author. On the left is seen a papillary cauliflower-like growth springing from a small multilocular cyst of the ovary which can be seen just below and to the right of the cauliflower mass. Some of the excrescences show cystic formation. On the right is seen a tube and ovary united by inflammatory adhesions. The ovary has the appearance of ordinary cystic degeneration. It was found by microscopic examination that this ovary is a very early papillary cystadenoma, the growth of which is entirely inverting instead of everting, as on the opposite side. As will be seen by reference to the microscopic drawings (Figs. 162 and 164), this specimen shows extraordinarily well the way in which the papillary cystadenoma develop from the germinal epithelium covering the ovary.

lary cystadenoma. The appearance of a malignant papillary cyst so closely resembles that of the benign cystomata that often they can hardly be differentiated macroscopically. The contents of a cancerous cyst are apt to be opaque or bloody, due to desquamation and breaking off of the papillary excrescences.

Microscopically, the anatomic appearance resembles closely that of cancer of the body of the uterus.

Serous cystadenomata are much more prone to undergo carcinomatous degeneration than is the pseudomucinous variety, especially if they show tendency to papillary growth. According to Pfannenstiel, at least one-half of the papillary cysts of the ovary are malignant, and, as they cannot always be distinguished from the benign form, all papillary cystadenomata of the ovaries should

be *surgically treated as if they were malignant.*[1] Clinically, the cystic carcinomata are extremely malignant, and tend to recurrence even when they are apparently entirely removed by operation.[2]

(*c*) *Metastatic Carcinoma of Ovary.*—It should be remembered that many cancers of the ovary are *secondary* to cancers of other organs, such as the stomach, gall-bladder, intestines, breast, uterus and tubes, pancreas, suprarenal gland, and kidney, and have the anatomic characteristics of the original tumor. It is a matter of debate as to how the ovary becomes secondarily involved by

FIG. 162.—SEROUS CYSTADENOMA OF THE OVARY.

Low power of a papilla. The top of the papilla, at the right, is very edematous as compared with its base, at the left. The tips of the papillæ may become so edematous as to appear cystic. The epithelial covering may consist of one to several layers of cells which, in the inverting type, where the papilla lies in a cyst, may show cilia. Dilated lymph-spaces are seen in the tip near the center, and a gland to the right. Above is a further branch of the papilla.

malignant growths starting so far away as the stomach or gall-bladder without infection of intervening organs. There are two theories to explain this: one that the disease travels by a retrograde transportation through the lymph-

[1] Erdmann and Spaulding have demonstrated in their series that papillary cystadenomata occurred bilaterally in 22.2 per cent. of cases. Microscopic examination of the specimens showed that 66.6 per cent. were cancerous or precancerous.

[2] R. H. Miller and L. E. Viko have reported a rare malignant cystadenoma of the psammomatous type, associated with ascites and hydrothorax. Radical removal was not feasible. The patient was followed for five years, during which time she was tapped 882 times, with the removal of 600,000 c.c. of fluid from chest and abdomen.

channels, and the other that the cancer cells of the original tumor escape into the peritoneal cavity and are carried by gravity and the peristaltic movements of the intestines to the surface of the ovaries, where they become implanted in the ovarian stroma by passing between the cells of the outer layer of germinal epithelium. Kraus has shown by experiments on animals that inorganic particles (carbon, etc.) injected into the upper peritoneal cavity may be found later actually invading the ovarian tissue through the interstices of the germinal epithelium.

The ease with which epithelium may be implanted within the ovarian substance is well illustrated by Sampson's theory of the histogenesis of chocolate

Fig. 163.—Malignant Papillary Cystadenoma of the Ovary.
(Low power.)

cysts. He believes as is shown elsewhere (see Chocolate Cysts) that particles of desquamated endometrium passing by retrograde motion during menstruation and becoming implanted on the surface of the ovary invade the stroma and produce the cysts by a continuation of their original function.

When cancer of the ovary occurs in association with malignant disease of neighboring organs, like the uterus or tubes, it is often difficult to determine in just which organ the disease was primary. This is due to the fact that adenocarcinoma of the uterine and tubal mucosa may exactly resemble adenocarcinoma originating from the gland inclusions of the germinal epithelium of the ovary, the fundamental tissue being in all three cases embryologically identical.

Pfannenstiel makes the following statement: "It seems probable that when ovarian cancer is associated with cancer of a similar type in distant organs the

FIG. 164.—SEROUS CYSTADENOMA OF THE OVARY.

Low power. To show inclusions of germinal epithelium in the stroma of the ovary. Two of these are seen. If the epithelium lining the inclusion is compared with the surface epithelium seen above, the activity of the former is understood. The cells are higher, the nuclei larger and stained deeper. These inclusions at first are circular or oval in shape. The one on the right shows the beginning of the inversion of the wall into the stroma of the ovary, with also a beginning papilla in the center of the lower edge.

disease of the ovary is usually *secondary*, while it is more commonly primary when the associated cancer is in neighboring organs like the tubes or uterus."

## IMPLANTATION TUMORS OF THE OVARIES

### Hemorrhagic Cysts of Ovary of Endothelial (Mullerian) Origin (Chocolate Cysts)

Russell in 1899 and, later, Lockyer, Cassler, and Cullen described endometrium-like structures in the ovarian stroma. In 1921 J. C. Janney, while reviewing and cataloguing the pathologic material of the Free Hospital for Women, chanced on three cases of the same kind, the reports of which he has published. The strange appearance of uterine mucosa in the ovaries remained a mystery until Dr. John A. Sampson read his epochal paper on the Chocolate Cysts of the Ovary, before the American Gynecological Society in May, 1921.

Before Samspon's discovery of the nature and histogenesis of these tumors, they had been a source of mystery and much speculation on the part of every pelvic surgeon. The curious syrupy or tarry character of their contents, the extraordinary density of their adhesions, the lack of evidence of pelvic infection from the usual causes, the presence of nodules and thickened areas beneath the peritoneum of the culdesac or in the wall of the rectum or sigmoid, have all been noted repeatedly and passed over as inexplicable phenomena. Most surgeons spoke of them as "corpus luteum" cysts, though with a vague sense of the inadequacy and incorrectness of the designation. Sampson in an attempt to learn the cause of the dense adhesions of chocolate cysts studied them closely, and found that the cyst walls contain gland-like structures identical with the uterine mucosa, and that the hemorrhagic content of the cysts is actually retained menstrual blood. One has only to think of the resemblance of the chocolate cysts contents to the dark tarry material found in the uterus or vagina in cases of gynatresia and wonder why the identity of the two substances has never before been suspected. Sampson then discovered that the cysts become perforated and that the contents pouring out into the peritoneal cavity caused exceedingly dense adhesions with contiguous surfaces such as those of the posterior culdesac, the anterior wall of the rectum, and the leaves of the broad ligament. He at first supposed that the adhesions were due to an irritating effect of the menstrual blood caused by some inherent ferment. Further study, however, revealed the important fact that endometrial glandular tissue can be found in the adhesions themselves, and that instead of being the ordinary organized adhesive bands formed by pelvic infection, they are, in reality, endometrial adenomata. Moreover, he made the still more important discovery that the glandular tissue, extruded from the cysts and appearing in adhesive bands, has an invasive tendency, and that the discrete or diffuse nodules often found in the culdesac, in the posterior wall of the uterus, and in the wall of the rectum or sigmoid, are seed metastases disseminated from the original chocolate cyst, in exactly the same manner as similarly placed metastases are sown from cancerous cystadenomata. In this way Sampson has established the nature of the mysterious rectovaginal adenomyomata described by Cullen, as well as many other adenomyomata of various parts of the female pelvis, the origin of which has up till now been a matter of futile speculation.

Sampson has practically established beyond doubt the histogenesis of the chocolate cysts. He discards the serosal theory of Lockyer, and that of Russell which presupposes an embryonic inclusion of the Müllerian epithelium. Nor does he give weight to the conjecture that the germinal epithelium which as we have seen has extraordinary powers of producing diversified epithelial structures, may in adult life invade the ovarian stroma and create a true endometrial mucosa. This theory, it may be said in passing, is not entirely unreasonable in view of the fact that the germinal epithelium is regarded by many as the embryonic progenitor of the Müllerian epithelium. He thinks rather that the en-

dometrial tissue is implanted in the ovary as a result of a back flow of menstrual fluid with its particles of desquamated uterine mucosa, through the tubal ostia. Having become implanted in the ovarian stroma and having by periodic menstruation produced a hemorrhagic cyst the glandular tissue may again be extruded into the pelvic cavity forming the characteristic adenomatous adhesions and invasive tumors.

In a later communication Sampson has shown that pelvic adenomata may be produced not only by implants escaping from a perforated hemorrhagic cyst, but also by the direct escape of endometrial tissue from the tubes. It is notable that the tumors originating from a perforated cyst are more invasive and have a wider distribution than do those found without evidence of an ovarian hematoma. As Sampson says, "the ovary appears to be a sort of intermediary host, hot bed, or incubator, which sometimes imparts a greater virulence to the epithelial cells developing in it."

Still another later development in Sampson's work reveals the fact that the implantation tumors, both in the ovary and in the pelvis, may be derived either from endometrial cells or from the mucosa cells lining the tubes, both structures being of Müllerian origin. He is able to distinguish between the two forms by the histologic appearance of the glandular structures. Thus tumors derived from the endometrium exhibit the characteristic cytogenous stroma in which the uterine glands are embedded, and which in the tumors of endosalpinx origin is scanty or entirely lacking. In the tumors derived from tubal mucosa the lining epithelium is more markedly ciliated.

In this connection it is necessary to refer to the uterine adenomyomata. As has frequently been demonstrated, these tumors may grow directly from the uterine mucosa, especially from that near the cornu or in the isthmus. It remained for Sampson to show that the adenomyomata may grow from the *peritoneal surface* of the uterus, from implants sown either directly from the tubal ostia or from perforated hemorrhagic ovarian cysts of endometrial origin.

Sampson claims that the endometrial hemorrhagic cysts are of extraordinary frequency, and even goes so far as to state that next to leiomyoma of the uterus "they probably furnish the most frequent pelvic lesions found at operation in women between the ages of thirty and the menopause. Of the ovarian hematomas over 30 per cent. occur bilaterally. In size they vary from being just visible to the naked eye to 9 cm. in diameter. They are classified into superficial and deep varieties. The superficial tumors perforate early. The deeper tumors may be multiple. The lining epithelium passes through menstrual cycles, exactly like that of the normal uterine mucosa, *i. e.*, hemorrhage around the gland structure, desquamation of epithelium, passage of blood into the lumen, and regeneration of the epithelium. The pressure of the contained blood in the cysts eventually produces rupture with escape of endometrial tissue into the pelvic cavity where it may become implanted. Retention of the blood creates

the dark chocolate or tarry appearance characteristic of menstrual blood retained in any manner.

*Clinical Features.*—According to Sampson the age incidence of hemorrhagic cysts of endometrial origin corresponds in general to that of myoma of the

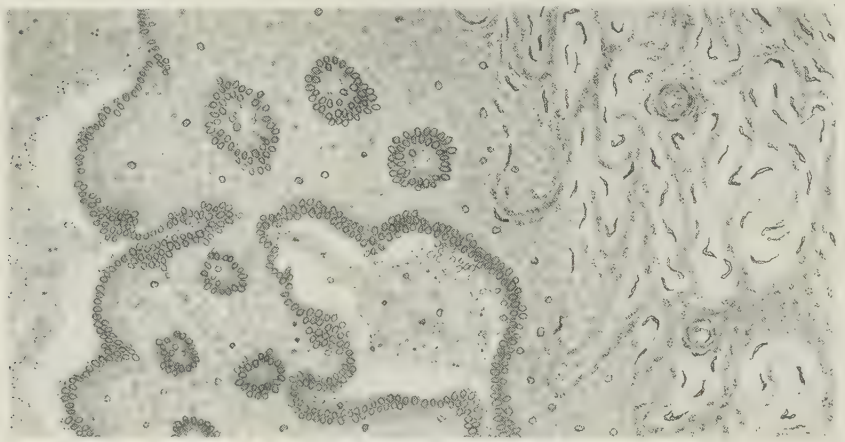

FIG. 165.—ENDOMETRIAL IMPLANTATIONS.

The left-hand two-thirds of this section is endometrial tissue, glands, and stroma, with the menstruum of old blood and detritus. In several regions the columnar epithelial cells can be seen in the act of secretion. The right-hand one-third shows ovarian tissue. Note the zone of greater cell density between the ovarian and endometrial tissue.

FIG. 166.—ENDOMETRIAL IMPLANTATIONS.

Showing part of the wall of a small cyst in an atrophied ovary. On the left, columnar epithelium or a connective-tissue stroma. On the right, ovarian tissue. Above, endometrial epithelium forming a sort of gland embedded in ovary.

uterus, that is to say, from about thirty years to about forty-five. Sampson had no case in which the patients had passed the menopause. Since the appearance of his paper we have encountered two such cases.

Of married women suffering from this disease the majority are either childless or acquire sterility after the birth of one or two children.

Subjective symptoms are, for the most part, due to adhesions. As in the cases of adhesions from other causes pain may be present or absent, and when present is not always proportionate to the extent of the adhesions. Dysmenorrhea is fairly constant and may be regarded as a definite symptom of the disease. There seems to be no characteristic effect on the amount of menstrual flow. Constipation is very common and may even be of an obstructive

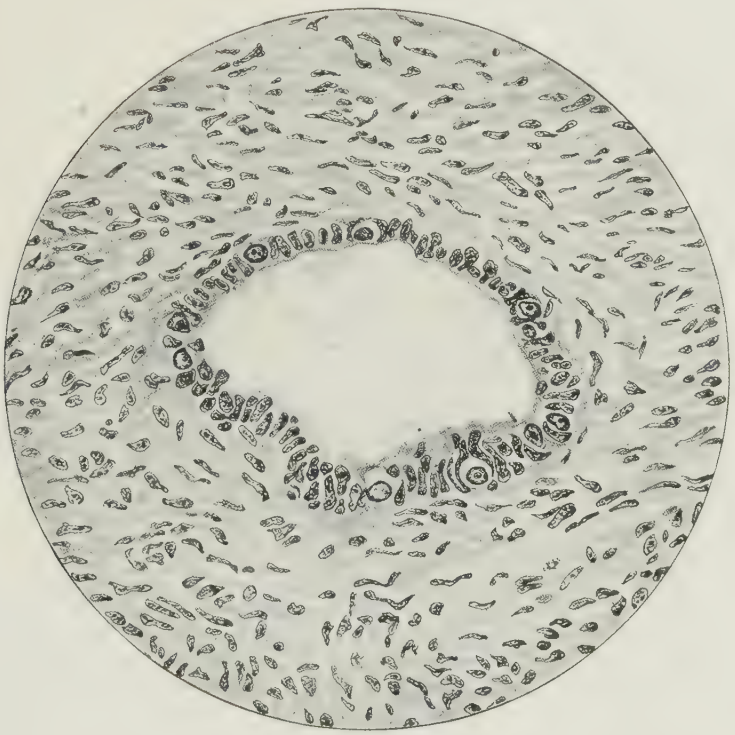

FIG. 167.—SEROUS CYSTADENOMA OF THE OVARY.

High power of an inclusion of germinal epithelium. The epithelial cells are cylindric, crowded together, irregularly placed, and contain large nuclei. The basement-membrane is absent. Several of the cells are swollen; their nuclei are large, contain definite nucleoli, and appear like germ-cells.

nature in cases where the lumen of the bowel has been constricted by the growth of adenomatous implants in the bowel wall.

Physical signs are, in general, like those of chronic pelvic inflammatory disease. In cases where adenomatous implants are situated in the posterior culdesac the condition simulates closely the feel of malignancy. The general clinical picture is, however, so unlike that of malignancy that the two diseases need rarely be confused.

Many cases exhibit an adherent retroversion, as would be expected from the effect on the uterus of dense adhesions in the posterior culdesac.

Under rare conditions patients with endometrial tumors may become pregnant, in which case, as Sampson has shown, the lining of the gland structures shows a characteristic decidual reaction.

The diagnosis of the condition is made by the presence of adherent masses and nodules in the pelvis, the age of the patient, dysmenorrhea, sterility, and exclusion of definite causes for chronic pelvic inflammation, which disease it simulates closely in its symptomatology. As to treatment, Sampson inclines to radical removal of the organs, though he admits that in certain cases conservative measures may be adopted.

**Ovigenous Tumors of the Ovaries.**—There are two forms of ovarian tumors, the dermoids and teratomata, that can be classified neither as parenchymatous nor as stromatogenous, in that they develop from germ-cell elements and contain in their structure tissues of all three germinal layers. They are, therefore, very appropriately called ovigenous or ovulogenous.

## HISTOGENESIS OF OVARIAN DERMOIDS

*Terminology.*—It is necessary to avoid confusion that exists in the use of the words dermoid and teratoma. It should be remembered that in this section the terms dermoids and dermoid cysts refer only to the ovarian tumors. The ovarian dermoids are to be carefully distinguished from the congenital dermoid cysts which are sometimes found at the lines of embryonic fusion, such as the branchial clefts, and along the mid-dorsal and mid-ventral lines. These latter tumors arise from epidermal inclusions and are true retention cysts. They are, therefore of an entirely different nature from the ovarian dermoids, which are true tumors containing a more or less irregular growth of the three dermal layers. The words teratoma and teratoid are used in a variety of ways. Teratoma is sometimes employed as a general term including the cystic or dermoid ovarian tumors, and the solid embryonic form. Specifically, ovarian teratoma is applied only to the solid embryonic tumors. We shall use the word in the latter sense. Teratoid is an adjective that may be applied to characterize the two ovarian tumors, *i. e.*, cystic and solid, that represent embryonic growths containing the three dermal layers. We shall use the term in this way, but it must be remembered that it is also properly applied to numerous forms of tridermal tumors that occur in other parts of the body.

*Histogenesis.*—From a histogenetic standpoint the ovarian dermoids and teratomata are perhaps the most interesting of all tumors, nevertheless our knowledge of their exact origin is at present only speculative. Certain constant characteristics point out at least the direction of their histogenesis. They both, with great regularity, contain products of the three original germ layers. They differ from each other in that the dermoids exhibit products that partially or completely recall fetal or mature organs of the human body, whereas in the teratomata the elements of the three germ layers grow with unrestrained license, the cell-structures being atypic in form, size, and arrangement. It is also significant that in both the dermoids and teratomata are chiefly represented those embryonic *anlagen* which are earliest and most completely developed, namely, the ectoderm, on the one hand, and the anterior embryonic segment, especially the head, on the other. In normal embryonal development the head portion is most advanced throughout intra-uterine life, both in size and in tissue differentiation. The same law obtains in dermoids of the ovary. As in the embryo the parts of the trunk and extremities reach full development comparatively late; so in the dermoids, they are either insignificant or entirely absent (Pfannenstiel).

There are at the present time two main theories of histogenesis. According to one, the tumors have their origin in wandering cells that date back to the earliest cell division of the

individual who harbors the tumor; according to the other theory, they arise from sex cells of the ovary. Of these the first is called the *blastomere*, and the second, the *germ cell* theory. The blastomere hypothesis is the more recent one, and perhaps at the present time is somewhat more widely accepted.

This theory may be better understood from the following abstract from Opitz and Menge:

A number of facts seem to contradict the theory that the dermoid and teratoid tumors spring parthenogenetically from an unfertilized ovum. Chief among these are the appearance of these tumors in parts of the body far distant from the ovary, and also their development in men not only in the testis, but in other parts of the body. Further, the structure of the tissues of a dermoid corresponds in a general way to the age of the patient who carries it. Also the absence of fetal membranes, which normally are developed before any of the tissues found in dermoids, contradicts the theory of origin from an unfertilized egg.

Finally, if it were possible for a dermoid to spring from an unimpregnated egg one would expect a much greater frequency of these tumors, considering the enormous number of unfertilized eggs that pass the tube. Nevertheless, only 5 authentic cases of dermoids in the tubes have been reported.

Since the dermoids and teratomata contain constituents from all three germinal layers (entoderm, ectoderm, mesoderm), it must be that they spring from cells that "stand close to" the fertilized ovum. This requirement is met by the so-called blastomeres, which are the products of the first cell division of the impregnated egg, and which experimentation on the lower animals has shown have, when isolated, the power of producing rudimentary embryos. It is readily conceivable that in the complicated processes of growth of the earliest embryonal time some of these cells may be displaced to the most diversified parts of the developing organism.

It has been proved by animal experimentation that the earliest segmentation divides the ovum into two kinds of blastomeres, those which become the later germ-cells (ova or spermatozoa) and those which enter into the construction of the body (somatic cells). It is conceivable that from some irregularity of development and arrangement of the primary cells a somatic blastomere may become displaced and included, for example, in the ovary, where it may either be destroyed undeveloped or, under the irritating influence of some chemical change in the blood or surrounding tissue substance, be awakened later from its dormant state to productive activity, and create a dermoid cyst or a teratoma. (Free translation.)

The older germ-cell theory still has many adherents, and judging from the literature there seems to be a certain tendency to reaction in its favor. Whereas by the blastomere theory the origin of the teratoid tumor is referred back to a sleeping cell that has lain dormant from the earliest segmentations of the mother ovum, by the germ-cell theory the tumors are supposed to develop from ova or egg-cells during extra-uterine life.

In order to understand this theory it is necessary to refer again to the origin of the germ-cells. We have described above in detail how the ovum seems to spring from the germinal epithelium that primarily covers the genital ridge, and we have also shown that the germinal epithelium appears to be itself a modified derivative of the peritoneum.

In all multicellular types the cells of the body eventually become differentiated into two very distinct groups, called by Weismann somatic cells and germ-cells. The *somatic cells* are employed to make up the tissues of the body and are differentiated into those various organs which perform the functions of life. The *germ-cells*, on the other hand, play no special part in the life functions of the individual, but are destined to form new individuals after detachment from the body. The clear differentiation between somatic and germ-cells takes place at different times in different organisms. In the very low multicellular forms the distinction takes place at the first segmentation of the ovum and remains obvious throughout the life of the organism. This simple illustration of the general principle is well exemplified by *Volvox*, a minute infusorian, whose hollow globular body is made up of two kinds of cells. The small somatic cells which constitute the supporting meshwork are employed in the functions of nutrition and locomotion. In addition to these there are several, usually eight, much larger germ-cells, which without sharing in supporting the life of the individual, are set apart entirely for the purpose of procreation. Each one of the larger germ-cells may by pro-

gressive fission form a new individual like the parent. In the more complex multicellular organisms the process is not so simple. Though it is probable that at the earliest segmentation the division into somatic cells and germ-cells takes place, a clear distinction between the two groups does not occur until a later date. Moreover, the germ-cells instead of being scattered about among the somatic cells, as in *Volvox*, become definitely segregated into special sexual organs that are supported and nourished by somatic cells.

At this point there arise two important questions that have not yet been conclusively settled. The first is whether the original somatic and germ-cells differ absolutely in kind or only in degree. The second question relates to the manner by which the germ-cells become aggregated into a single pair of organs situated at some distance from the first place of division. We are for the moment chiefly interested in the second of these questions.

According to Weismann, the germ plasm, that part of the germ-cell which is capable of producing a new individual, is transmitted from the original ovum through a series of cell divisions along definite "germ-tracks" until it reaches the final resting-place in the collection of cells that represent the sex organ. Here it impresses on the last cell in which it resides the particular character of a true germ-cell or ovum. From then on it becomes inactive and no longer proliferates normally, unless impregnated by the male sperm.

The process of transmission thus described by Weismann is purely hypothetic. If we accept his theory it would be necessary to regard the sex-cells as entirely distinct in kind from the other cell elements that we have seen are clearly derived from the germinal epithelium. It is difficult to believe that these cells have migrated to the genital gland and become mingled as strangers with the proper cells of that organ. And this theory is still more difficult to believe in the light of the work of Goodall, McIlroy, and others, who have shown convincing proof that the egg-cells are derived by a process of differentiation from the germinal epithelium.

Inasmuch as the germinal epithelium has every appearance of being a differentiated product of the peritoneum it does not seem probable that in complicated organisms the continuity of the germ is *direct* from the first segmentation of the ovum. On the other, hand it seems evident that the immediate ancestors of the germ-cells pass through a somatic stage, *i. e.*, peritoneum and germinal epithelium. We must therefore conclude that the original distinction between the somatic and germ-cells was not one of kind, but rather one of degree.

By accepting the theory of indirect continuity of the germ-cell, and assigning its immediate origin to the germinal epithelium, the histogenesis of the dermoid cyst becomes much easier to explain than by the blastomere theory.

The blastomere is a cell of the earliest division, which remains inactive, but with the latent power to produce under proper irritation the three embryonic germ-layers. In order to explain its location in distant organs a wandering, or inclusion, or misplacement must be assumed as having taken place during the early differentiation of organic tissue. One can hardly imagine how these isolated blastomeres could assemble in the ovary with such regularity and often in such numbers.

The occurrence of multiple dermoids is not uncommon, as many as eleven having been described as arising from one ovary alone, while a case has been reported in which 21 were found in both ovaries combined. Another argument in favor of the ovigenous origin of teratoid tumors is the frequent occurrence of dermoids with ovarian cystadenomata. As we have shown, the cystomata probably originate from germinal epithelium. A function of the ingrowing germinal epithelium is to surround the primitive ova. According to Krosmer, in these combination tumors the cystadenoma represents a neoplasm from the surrounding germinal epithelium, and the dermoid is a growth starting from the enclosed egg-cell.

By the germ-cell or ovigenous theory of the origin of dermoid tumors, the ovarian growths are readily accounted for, but the occurrence of these tumors in other places of the body is more difficult to explain. Here again resort has been taken to the misplacement theory, which is always unsatisfactory. It is, in fact, harder to explain the inclusion or misplacement or wandering of an ovum than it is of a blastomere. It seems more reasonable in accounting for the extra-ovarian teratoids to assume an irregularity of physiologic function on the part of certain embryonic cells. This at least avoids the difficulty of "transposing" isolated cells from one part of the body to another. Thus, if we accept the well-nigh proved theory that

the germinal epithelium is derived from the peritoneum, it seems quite possible that the peritoneum may sometimes deviate from its appointed function of differentiating into germinal epithelium in one particular area (*i. e.*, the genital ridge), and may produce germinal epithelium elsewhere. This irregularly placed bit of germinal epithelium may then give rise to an egg-cell with the power of developing into a teratoid tumor. In support of this theory is the well-known fact that the great majority of extra-ovarian teratoid tumors have their origin *in the subperitoneal connective tissue.*

There are certain well-known facts that support the theory of the ovigenous origin of the dermoids and teratomata. No one has ever observed a dermoid in a fetus (Phannenstiel), nor has anyone ever proved that these tumors may start to grow after the menopause of their host. In other words, dermoids and teratomata are developed only during active ovarian life. Dermoids are not infrequently found in elderly women, but as the tumors grow very slowly there can be no doubt that they had started to develop before the patients reached the menopause. The formation of dermoids may take place during childhood. Although no one has yet demonstrated a dermoid in a fetus, the discovery of one would not discount the theory of their ovigenous origin, for the fetal ova are active at that stage, as shown by the evidence of follicle atresia seen at birth. Teratomata, the growth of which is rapid and fatal, have never been encountered in women after the climacterium.

The coincidence in time of development that exists between dermoids and the normally maturing ova constitutes one of the principal arguments against the blastomere theory of origin. According to the latter theory it is assumed that the blastomere is a cell of latent totipotency which may be awakened into activity during *any* period of the life of the host. One would therefore expect to find dermoids and teratomata starting into growth after the menopause, but, as we have seen, this is not the case.

If we accept the ovigenous theory of the origin of dermoids, our next inquiry must be directed toward the stimulus which awakens the ovum into its abnormal development. Here again we are on speculative ground, for this is a point that is not scientifically known. It presupposes some form of irritation. This irritation may be inherent in the cell itself, in which case it might be better described as a property of *irritability,* that is to say, the sex-cell may possess a too great tendency to evolve into the three germ layers, the normal development of which constitutes a new complete organism. But as complete development is attained only after fertilization by the male element the result of such an abnormal tendency on the part of the sex-cell is incomplete; or, in other words, a dermoid or teratoma is formed. On the other hand, the source of irritation may be external to the sex-cell and may be due to some abnormal stimulus, chemical or otherwise, on the part of the surrounding tissues. This possibility is substantiated by the famous discoveries of Loeb, who in experiments on the egg-cells of sea-urchins caused them partially to develop under the influence of an artificial chemical stimulus.

The process by which an egg-cell obeys its inherent tendency to produce a new individual without external fertilization is commonly called *parthenogenesis,* a term objected to by some as lacking in scientific accuracy.

In the description above of the cell derivatives from the germinal epithelium it was shown how the sex-cells pass through rather definite stages of development before arriving at the point of being a ripe egg. These stages have been designated in order as (1) the primitive sex-cell; (2) the oögonium, or primordial egg; (3) the oöcyte or mother-cell egg, and (4) the ripe egg or ovum. It has been suggested that the dermoids and teratomata attain only an incomplete growth as a result of having developed from the egg-cell during an early stage of its evolution. Others have suggested that the difference between the dermoids and teratomata depends on the age of the sex-cell from which it takes its origin. The tissues of teratomata are embryonic in character, the tumors grow rapidly and are of a malignant type. The dermoids, on the other hand, though probably having a rapid initial stage of growth, in general grow slowly and exhibit a mature type of organized tissue. They are not malignant. It has been claimed that the teratomata, or embryomata as they are sometimes called, develop from sex-cells of an early differentiation, whereas the dermoids originate in cells of a more mature development. There is no scientific proof for either of these last two theories.

We may sum up our conclusions from a study of the histogenesis of ovarian dermoids and teratomata as follows:

1. These tumors probably take their origin from the egg-cells of the ovary rather than from wandering or enclosed blastomeres.

2. The post-peritoneal dermoids probably originate in immature egg-cells that are abnormally differentiated from peritoneal cells outside of the area of the genital ridge.

3. The stimulus to autonomous or parthenogenetic growth of egg-cell resulting in a teratoid tumor is not known, but is probably of a chemical nature.

## DERMOIDS[1]

*Gross Anatomy.*—Ovarian dermoids are cystic tumors of an oval or globular form. An irregular contour usually indicates that the tumor is combined with a cystadenoma, an occurrence that is not infrequent. The surface is smooth and glistening unless complicated by adhesions or necrosis. The cyst wall is usually thin and transparent, but sometimes thick and opaque, and may contain bony or cartilaginous masses, that give a solid feel to parts of the tumor.

The size of dermoids varies from that of a pea to that of a man's head. The majority of the tumors are well pedunculated and follow in their growth the usual path of migration in the abdomen. Occasionally they may be intraligamentary, presumably in cases where the point of origin was close to the hilum of the ovary. The gradual growth of the tumor destroys most of the ovarian tissue which becomes thinned out over the surface, but even bilateral growths do not destroy the ovarian functions before a long period of time.

Ovarian dermoids are sometimes found attached to the broad ligament, with both ovaries intact. It is probable that these tumors arise from a "third ovary." They should be distinguished from the true dermoid tridermal cysts which may develop in the subperitoneal connective tissue.

The consistence of a dermoid cyst changes with the surrounding temperature. At body temperature as it lies *in situ* it has a purely cystic feel and one can often see through the transparent wall solid bodies swimming about in the fluid contents. When after removal the cyst has become cooled the consistence is doughy, the surface pits on pressure, and the wall becomes stiff, opaque, and somewhat wrinkled.

The fluid contents of the cyst at body temperature consist of a rather thick oily substance which on cooling rapidly assumes a semisolid pudding-like character. It is made up of fat, fat accretions, desquamated epithelium and usually cholesterin crystals. In the midst of this material is usually found a tangled mass of hair, and occasionally teeth and bits of bone.

If the tumor has undergone a torsion of the pedicle the contents may be suffused with blood so that they acquire a cloudy, brownish appearance. Under such circumstances there are sometimes to be seen small balls of fat varying

[1] Based chiefly on Pfannenstiel and Veit's Handbuch.

in size from that of a pea to that of a hen's egg, which have formed about hair or some epidermal concretion.

The method of formation of these curious fat-balls has aroused considerable discussion. According to Rokitansky they are the result of a fat-coagulation with hair as the point of concentration. Gebhardt thinks they are the result of a "butter formation" induced by the movements of the body. Pfannenstiel regards them as due to an albuminous bloody exudate, as he finds them only in association with the conditions resulting from a twisted pedicle.

When a dermoid and cystadenoma are growing together the contents of the dermoid may be mixed with those of the cystoma, as a result of a rupture of the septum separating the two cysts.

When the contents of a dermoid have been thoroughly cleaned from the inner wall, as is best accomplished by washing with very hot water, it will be seen that projecting from one part of the wall is a whitish skin-like prominence to which are attached numerous hairs. The rest of the cyst wall is smooth like that of an ordinary cyst. The thickened portion, sometimes called the "plug" or "bung" of the cyst, represents the real parenchyma of the tumor, for it is in this portion that the specific tissues derived from the three embryonic germ layers may be found. The plug is usually situated on the wall of the main cyst, or on the septum between two neighboring cysts. Sometimes it extends like a bridge across a cyst cavity.

In one case observed by Pfannenstiel the plug in the form of a ball was attached only by a thin pedicle to the wall of the cyst. The plug varies much in size and contour. It may exist only as a flat elevation or it may be a prominent protuberance into the cyst lumen of considerable size. It may present a smooth surface, or it may be knobby and irregular as a result of bony growths embedded within its tissues. The plug, at least in its superficial parts, undoubtedly represents the *anlage* of the head. The characteristic and usually present tuft of hair springs from the plug, as do also the teeth and bony structures so frequently found in the dermoid cysts. The *hair* of the dermoid is usually found in a tangled mass, occasionally in well-defined locks. Much of the hair is dead and broken and lies free in the cyst. It may reach a considerable length, sometimes as much as a foot or even a yard. In addition to the long streaming hair that grows from the plug, shorter, lanugo-like hairs may be found growing in the otherwise smooth wall of the cyst. Both ends of these shorter hairs are often implanted in the cyst wall, and cause a sort of inflammatory reaction, so that the surface from which the hairs grow, instead of being white like that of the plug, has a reddish, raw appearance.

The long hairs from the plug may grow across the cyst cavity and become implanted on the opposite wall, and even grow through the wall to appear on the outer aspect of the cyst. In combination cysts the hair of the dermoid may grow through the septum and mingle with the contents of the cystoma.

The color of dermoid hair presents curious variations, from silver-white to

blond, red, brown, and black. The hair of the dermoid and the hair of the patient are not necessarily identical in color. Very often the color of the cyst hair varies in the same tumor, presenting a number of different shades. Blandin has reported a case of a dermoid removed from a seventy-five-year-old woman. It contained very long hairs which were blond at the free end, dark in the middle, and white at the attached end. The color of the hair bears no relationship to the age of the patient, nor to that of the tumor, for white and gray hairs are sometimes found in the dermoids of young patients. Negroes

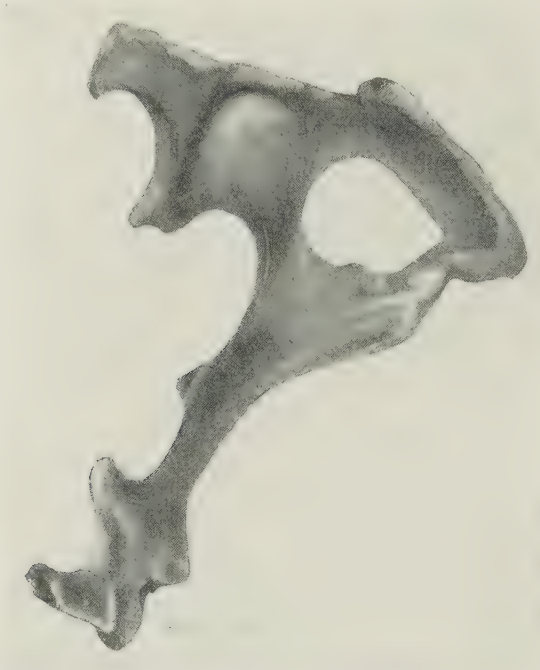

Fig. 168.—Specimen of Bone Removed from Dermoid Cyst. Several Expert Anatomists were Unable to Identify It.

and mulattoes show the same variety of hair color in dermoid cysts as do white women.

The general character of the hair from the plug corresponds to that of head hair, and undoubtedly that portion of the plug which produces the hair represents the scalp. In cases where the development of the fetal *anlagen* has been more extensive typical pubic hair has been found.

Occasionally but rarely dermoid tumors are encountered entirely free from hair. In such cases the cysts are filled only with an atheromatous pap.

Next to hair the most common derivative of the ectoderm found in dermoids are epithelial formations of the mouth cavity, and of these the most

frequent are teeth and portions of the jaw. The mouth may itself be represented by an enclosed cavity lined with squamous epithelium into which mucous glands like those of the normal buccal cavity pour their secretion. In the tissue surrounding this enclosure are often found teeth either embedded in connective tissue or encased in bone. The crowns of the teeth may project into the cusp lumen or may be completely buried in the tissue, or they may lie free on the surface of the cyst wall.

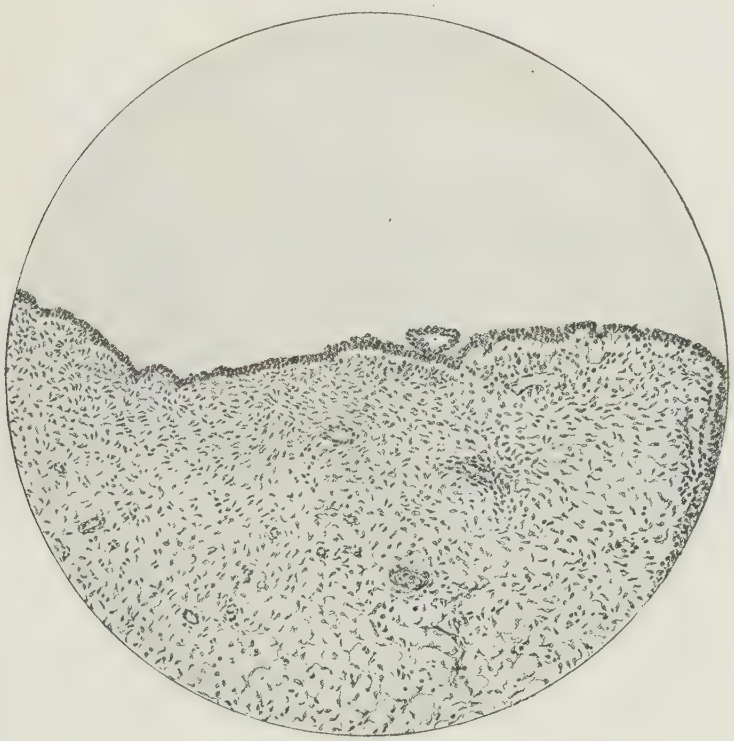

FIG. 169.—SEROUS CYSTADENOMA OF THE OVARY.

Low power. This section is taken from the surface of an ovary which contained a serous cystadenoma and shows the activity of the epithelium covering the ovary. The cells are becoming cylindric in shape, the nuclei are larger and stain stronger. At one point the beginning of a papilla is seen, the stroma is growing out, pushing the epithelium with it. The stroma is edematous and contains many dilated blood-vessels.

The structure of the individual teeth corresponds in a general way to that of normal teeth. Thus one finds typical bone, enamel, cement, and pulp. In cases where the teeth are attached to a portion of jaw bone there is the usual division into incisor and molar types. Dermoid teeth, however, do not usually present so complete a development as this. Harris has classified them as follows: Typical teeth, *i. e.*, like the normal, "plug" teeth, "knob" teeth, and those without any distinguishing form. There are also adult, twin, and rudimentary forms. Defects in the enamel and cement are frequently found. One

observer, Heschl, found carious teeth in a necrotic tumor. The number of teeth in a given dermoid is usually less than the normal, but may greatly exceed it. The highest records reach figures between three and four hundred. Such a multiplicity of teeth is produced by a repeated growth from the parenchymal plug, each new generation pushing its predecessors out into the cyst lumen.

The portions of jaw from which the teeth grow may represent the upper or lower malar bones. Sometimes a considerable part of the jaw may be well developed.

Besides teeth and jaw fragments, a great variety of incomplete portions of the skeleton have been observed in dermoid cysts, such as bone plates from the

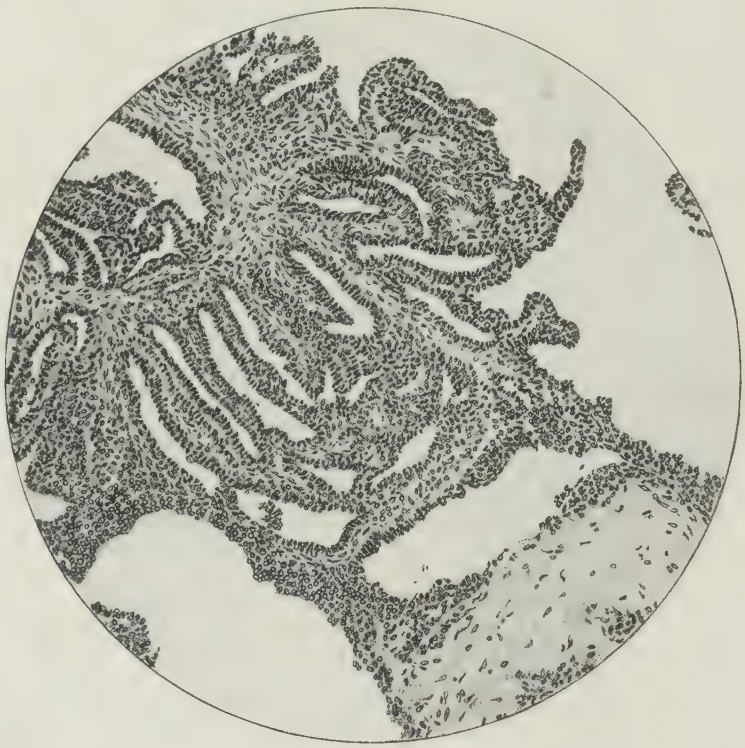

FIG. 170.—PAPILLARY ADENOCARCINOMA OF THE OVARY.

Low power. This section shows the glands with the thin trabeculæ of stroma between them. These glands are lined by a single layer of cells, but often several layers are found and sometimes the lumen is filled. In the upper part the papillary formation is shown.

skull, phalanges of a finger with nail attached, rudimentary parts of both upper and lower extremities, the scapula, the clavicle, ribs, etc. A few cases have been observed in which nearly the whole skeleton was represented, and had the appearance of an included fetus. Such a fetus must be regarded in the light of a parthenogenetic growth and is not to be confused with a true monster or twins, which develop from fertilized ova.

In addition to the bone elements above described representatives of the mesoderm in dermoids consist chiefly of connective tissue, fat, and smooth muscle-fibers. Striped muscle has only rarely been observed. The blood-supply of the parenchymal plug is derived from the ovarian circulation, but it is probable that in some cases an attempt is made by the tumor to create blood-vessels. The pulp of dermoid teeth, for example, is furnished with nerves and blood-vessels. Wilmo found a portion of a large vessel wall which he con-

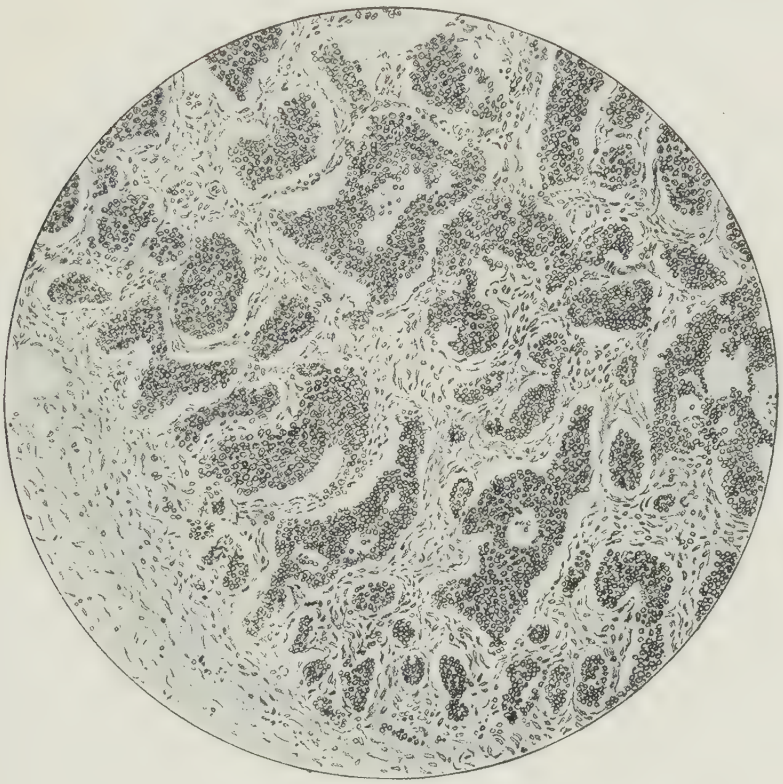

FIG. 171.—CARCINOMA OF THE OVARY.
Low power. This illustrates the solid carcinoma of the ovary consisting of alveolar masses of cells growing in the stroma of the ovary.

sidered as representing a carotid artery. Gebhard suggests that the occasional presence of bone-marrow indicates that the tumor may produce an irregular sort of blood building. No evidence of a heart formation has ever been demonstrated, so that, as Gebhard points out, an individual circulation of a dermoid cyst is impossible.

Glandular organs are sometimes well developed in dermoids, and of these the most important is the thyroid. It may be recognized by the bright yellow contents of its alveolar chamber. Salivary glandular tissue has been seen in

association with elements of the jaw bone, and in at least one authentic case mammary tissue has been demonstrated.

Other derivatives of the entoderm are only rarely found in dermoids. Occasionally intestine-like structures, lined with cylinder epithelium, have been seen. A few reports have been made of tissues from the respiratory tract, such as parts of the lung, and in one case an infant trachea (Baumgarten).

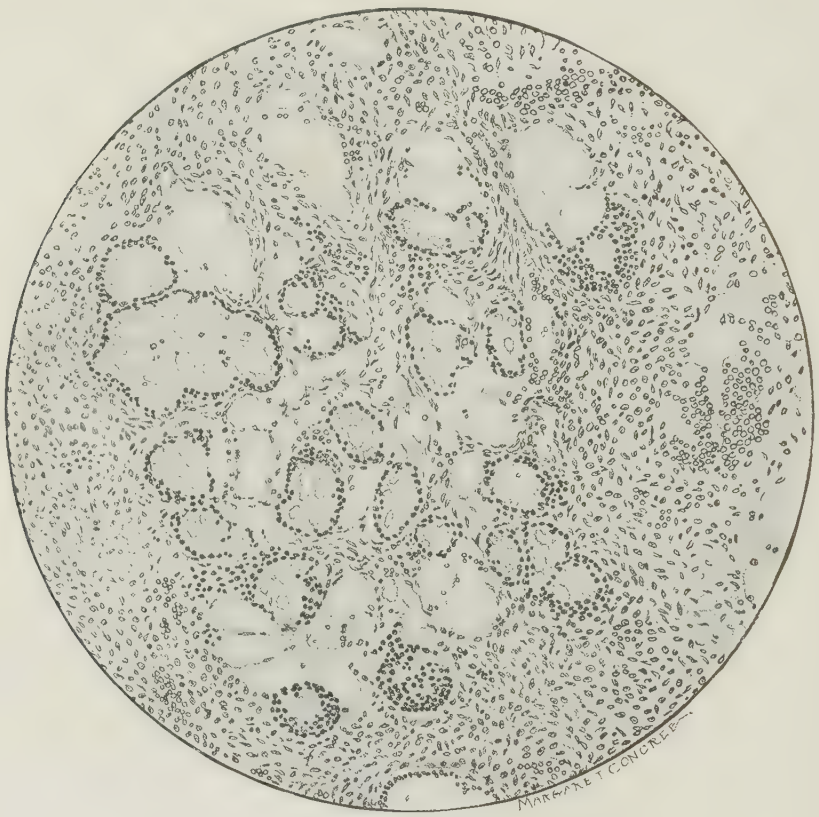

FIG. 172.—COLLOID CARCINOMA OF THE OVARY.

Low power. Scattered through the section are glands, lined by a single layer of high cells. Many of the glands are filled with mucus. The rest of the tissue consists of ovarian stroma. This growth was metastatic from a carcinoma of the sigmoid and the glands are characteristic of that.

Brain tissue elements sometimes appear in dermoid cysts in the form of grayish masses in which one observer (Baumgarten) has distinguished convolutions. The brain masses are said to be the seat of hemorrhages (Ewald), another example of the dermoidal origin of blood-vessels. The most common brain derivatives found are portions of the eye, lying near or embedded in the brain-tissue mass from which they take their origin. Rudimentary parts of the eye described are the cornea, lens, and even the eyelid with lashes.

The cyst content is proteolytic and corrosive, and when discharged into the abdomen by rupture of the cyst wall is conducive to peritonitis.

The **teratomata** are rare tumors allied in their structures to the dermoids in that all three germinal layers are represented. Unlike the dermoids, however, they are essentially malignant. The tissue elements are mingled indiscriminately, and for the most part represent an embryonal stage of development.

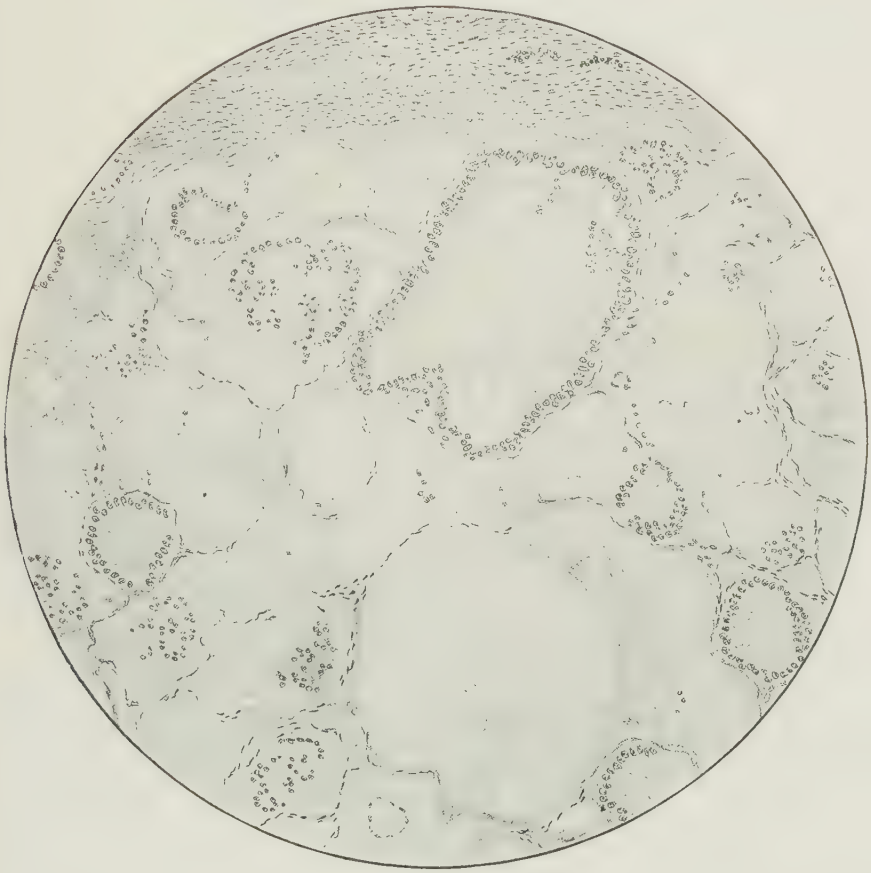

FIG. 173.—COLLOID CARCINOMA OF THE OVARY.

High power of the section shown in the previous drawing. This shows the typical cylindric epithelium associated with the large intestine. The epithelium has fallen out of many of the glands, leaving spaces.

The tumors grow rapidly and metastasize freely. They reach a large size, are irregular in contour and solid in consistency, with occasional great cystic cavities. Microscopically, all tissues of the body are found mingled in a lawless growth.

Less than 50 cases of teratoma of the ovary are found in the literature.

Struma ovarii is a term applied to tumors of the ovary, which in their histologic appearance and by the iodin test are proved to be thyroidal in character.

These tumors are often malignant, produce ascites, and tend to metastasize. There has been much speculation as to their origin, it being at first supposed that they represent a metastasis from the thyroid gland tissue. It is now believed that they constitute a special form of teratoma (Pfannenstiel), or that they represent malignant degeneration of thyroid tissue included in a dermoid cyst (von Franque).

**Stromatogenous Tumors of the Ovary.**—The stromatogenous tumors spring from the connective-tissue stroma with which the ovary is richly supplied.

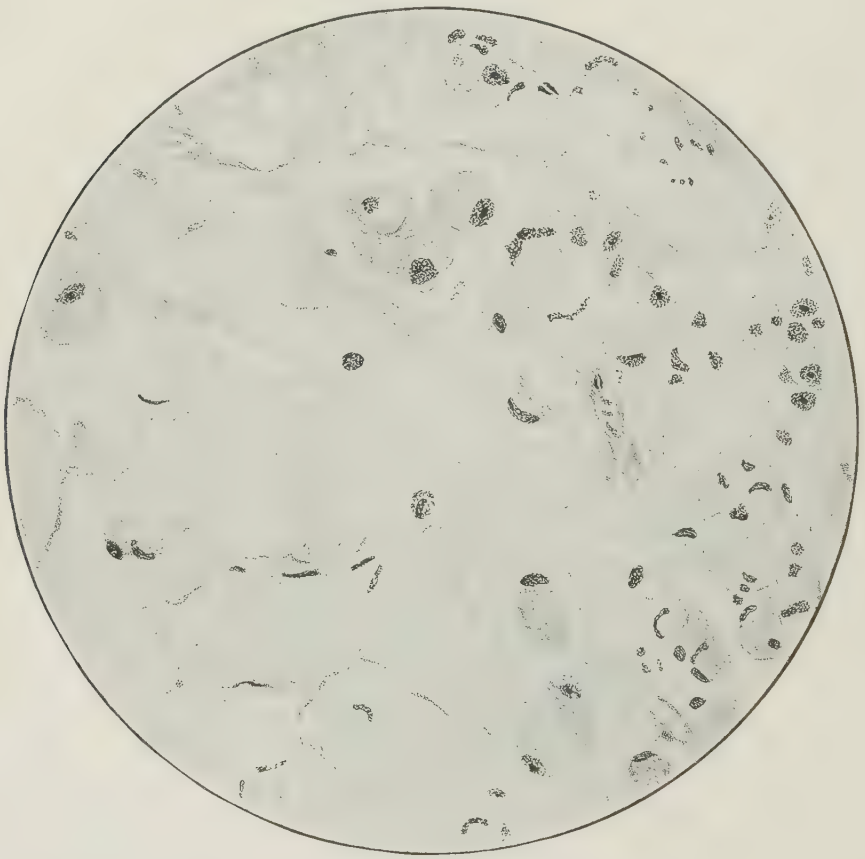

FIG. 174.—COLLOID CARCINOMA OF THE OVARY. (METASTATIC.)
High power. This shows the large cells with the eccentrically placed nucleus characteristic of Krukenberg's tumor. When cut in the right plane, as in the lower right and middle parts of the drawing, they have the appearance of a seal ring.

The benign tumors are represented by the fibromata, which appear either as small circumscribed growths or as diffuse neoplasms forming large solid tumors.

The circumscribed fibromata represent a local hyperplasia of the ovarian stroma, which in some cases can with difficulty be differentiated from the fibrous changes of an interstitial oöphoritis. In other cases the fibromatous

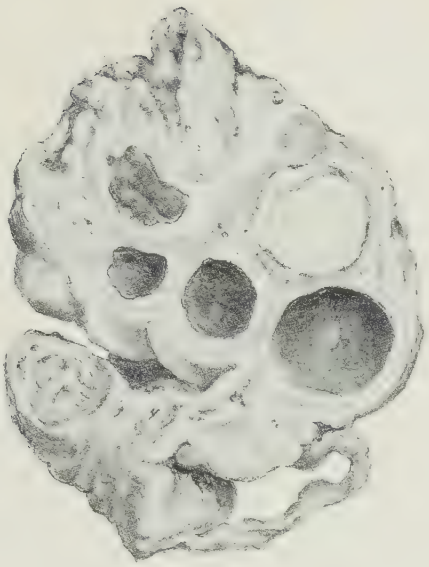

FIG. 175.—DERMOID CYST.

Very low power. Section of the whole ovary. On the right is a white, well-defined area which is a small dermoid cyst. Its contents consist of yellowish, greasy material containing hair. The three cavities below are small follicular cysts and the one above to the left is a corpus luteum.

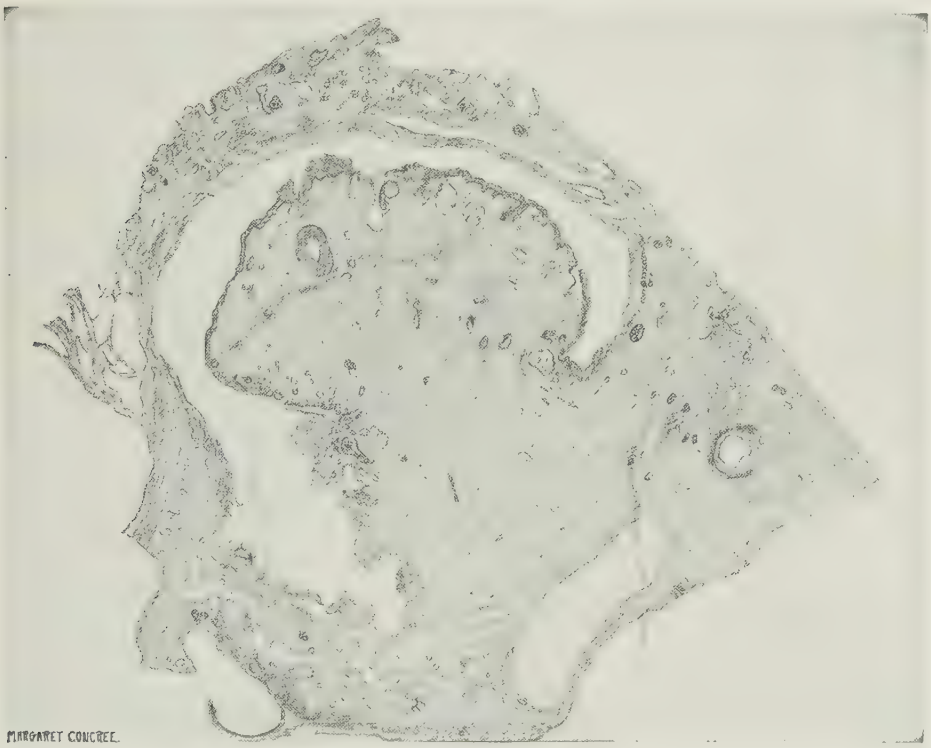


FIG. 176. –DERMOID CYST.

Very low power. Section of the small dermoid cyst shown in the last drawing. This shows the so-called plug of the dermoid cyst extending into the cavity. It is covered with stratified squamous epithelium under which are sebaceous glands and hair-follicle. A hair-follicle can be seen to the left of the middle of the plug near its surface. This is a very early stage in the development of a dermoid cyst. They are seldom found so small.

growth is near the surface, and appears as a tuberous or papillary wart-like excrescence. Another form of circumscribed fibroma has its origin in a corpus luteum. These tumors have a definite capsule. They have a dense fibrous central structure surrounded by a cortex of yellow or reddish-yellow color, in which lutein cells can be demonstrated.

The circumscribed fibromata have very little clinical significance. Diffuse fibromata represent a general hyperplasia of the ovarian stroma, which pro-

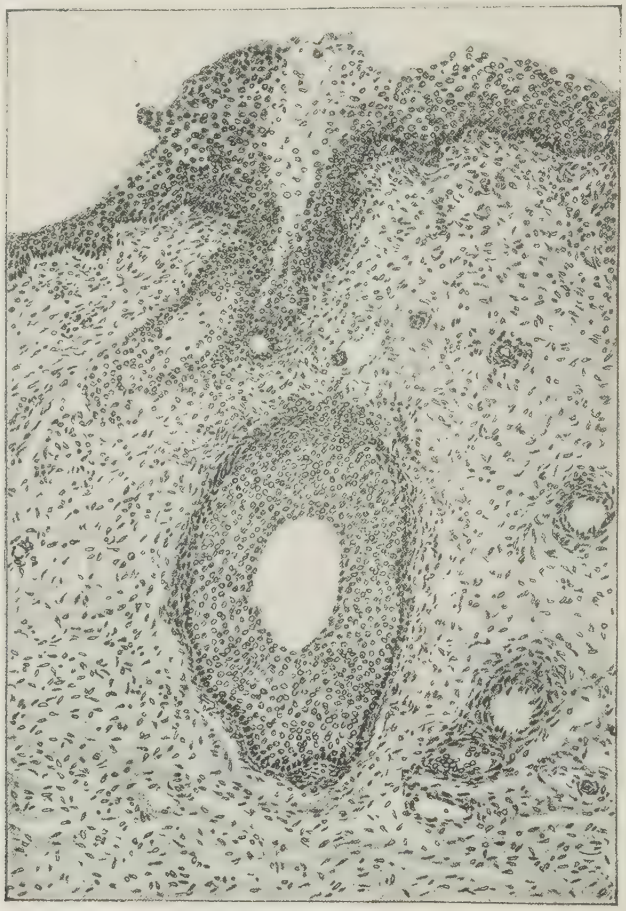

Fig. 177.—Dermoid Cyst.

High power. Showing the edge of the plug which is covered with stratified squamous epithelium. At the middle is the entrance to a hair-follicle, the continuation of which is seen below in the center of the drawing. The stroma consists of connective tissue infiltrated with a few leukocytes.

duces a large solid tumor that always preserves an ovarian contour. Cross-section shows a whitish dense homogeneous connective-tissue substance. Often the tissue is softened by edematous infiltration of the lymph-spaces, which, microscopically, gives the appearance of myxomatous tissue. The edematous infiltration may be so extensive as to form cystic cavities filled with clear colorless fluid. Occasionally hemorrhagic areas are seen.

Muscle-fibers have been demonstrated by good authorities in these tumors, but their presence is rare.

Diffuse fibromata may grow to a very large size. They are characterized even when of moderate size by causing ascites, though in what way this is brought about is not known. Pfannenstiel ascribes the ascites to a chemical

FIG. 178.—ROUND-CELL SARCOMA OF THE OVARY.

Low power. The upper part of the drawing shows the tumor, characterized by its round cells lying close together. There are many blood-vessels scattered through it. The light band is part of a corpus albicans and at the bottom is a small area of normal ovarian stroma.

irritation of the peritoneum. Schauta considers it to be due to pressure and stasis of the blood-vessels of the parametrium.

The diffuse fibromata may undergo sarcomatous degeneration.

**Sarcoma.**—Sarcomata of the ovary are rare tumors. They may originate as a malignant growth, or they may represent a degeneration of a fibroma. In about one-fourth of the cases reported they occur bilaterally. They closely resemble ovarian fibromata, and can often be distinguished from them only by the microscope. Ascites is always present, but this is not a special mark

of malignity, because it is usually associated with all solid tumors of the ovary.

The sarcomata have an early tendency to metastasis, which takes place into the retroperitoneal lymph-glands, and finally on the visceral and parietal peritoneum. Anatomically, these tumors may be of the spindle-cell or round-cell variety of sarcoma. The former, according to Gebhard, are smaller, have less tendency to metastasize, and occur at a more advanced age than the latter, and closely resemble fibromata, from which they are sometimes to be distinguished with difficulty. The round-cell variety occurs at an earlier age, often

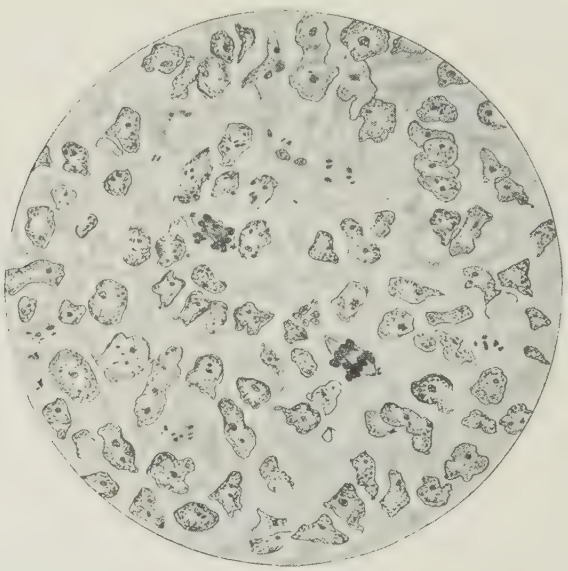

Fig. 179.—Sarcoma of Ovary Showing Mitotic Figures. High Power.

in children, and is much more malignant in type than the spindle cell. These tumors are especially liable to be bilateral.

Included with the sarcomata are malignant tumors which spring from the adventitial connective tissue immediately surrounding the ovarian blood-vessels (perithelioma) and from the endothelium lining the blood- and lymph-vessels (endothelioma). These tumors closely resemble the round-cell sarcomata and, clinically, need hardly be distinguished from them. They are frequently cystic.

In general, the sarcomata can be macroscopically differentiated from fibromata by the softness of the tissue, which usually shows areas of necrosis, fatty degeneration, and hemorrhagic infiltration.

*Hypernephroma.*—Primary hypernephromata of the ovary have been described. According to Gordon (Brit. Med. Jour., 1919) these are due to fetal rests. Up to the third month of fetal life the genital glands are in intimate contact with the suprarenal bodies. It is conceivable that when the testicle or

ovary descends it may carry with it fragments of the suprarenal body which may later act as starting-points for a hypernephroma.

### SYMPTOMS OF OVARIAN TUMOR

Uncomplicated tumors of the ovary may cause little or no trouble until they reach a considerable size. Tension on the ovarian substance by the growing tumor seems to give no pain. When the growths are well pedunculated and very movable, they rise out of the true pelvis as they increase in size and ride freely in the lower abdomen without giving pressure symptoms until their weight becomes noticeable or until they become complicated in some way.

If, however, the ovarian tumor is growing in between the leaves of the broad ligament or becomes complicated by pelvic adhesions so that it cannot move freely, pressure symptoms appear early, consisting of a sense of weight and fulness in the pelvis, backache, difficulty in micturition or defecation, and pains in the hips and thighs as a result of pressure on the pelvic nerve plexuses. There may also be evidences of passive congestion from pressure on the pelvic blood-vessels, such as edema and varices of the lower extremities, or of the external genitals or of the abdominal wall.

Intraligamentary tumors are especially apt to interfere with the ureter, which may be dislocated or compressed, so as to cause a hydro-ureter or a hydronephrosis. The dislocation of the ureter greatly increases the danger of operation. The papillary cystadenomata have a tendency to become intraligamentary, while the pseudomucinous cysts, fibromata, and dermoids, being well pedunculated, seldom develop in the broad ligament.

When ovarian tumors reach a large size, so as to fill most of the abdominal cavity, symptoms of pressure on the intestines, stomach, and diaphragm appear. Digestive disturbances, difficulty in breathing, and a gradual emaciation are characteristic. A peculiar drawn look about the face is commonly referred to as the ovarian facies.

Papillary cystadenomata, cancerous cysts, and all solid tumors of the ovary are usually associated with ascites. If the ascites is bloody it usually indicates malignancy. When ascites is present, general pressure symptoms appear more quickly and are more severe.

Non-malignant proliferating tumors if not interfered with continue to grow, and eventually cause the death of the patient by a general marasmus. Non-proliferating retention cysts if not complicated by torsion or adhesions may be carried for years without doing damage, though always in danger of complications.

Rupture of ovarian cysts occurs in a small percentage of cases. It may be the spontaneous result of increasing internal pressure on a wall that is gradually being thinned out, or of a necrosis or other degenerative process of the cyst wall. The rupture may be caused by trauma, such as a fall or kick, or violent abdominal pressure, or from childbirth, or from a bimanual examination. The effect of rupture may or may not be serious. If it involves an injury of the

large blood-vessels of the cyst wall there may be sudden fatal hemorrhage into the abdominal cavity. Otherwise the symptoms of cyst rupture are slight, the patient noticing chiefly the sudden diminution in the protuberance of her abdomen.

As a rule, the ruptured opening of the cyst wall becoming involved in adhesions closes, and the cyst again fills to its former proportions. Exceptionally, the opening persists and the cyst secretions continue to pour into the abdominal cavity.[1]

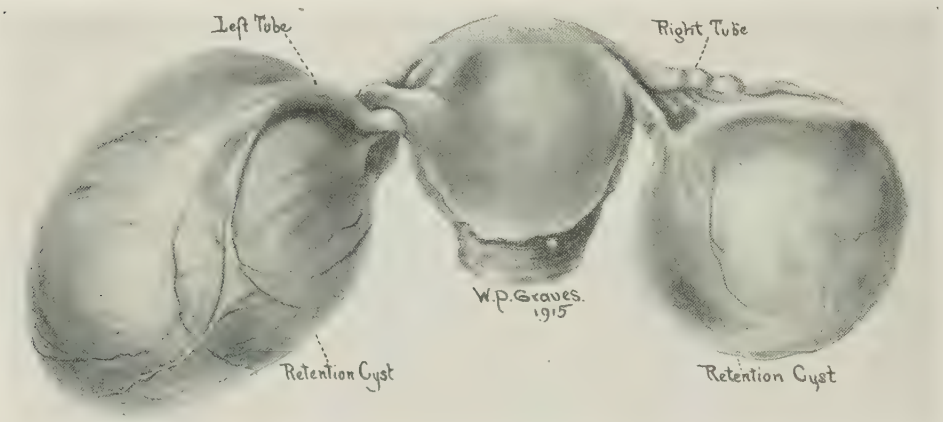


FIG. 180.—DOUBLE OVARIAN CYSTS, SHOWING TORSION ON ONE SIDE.

The pedicle has undergone one complete revolution. The cysts are of the non-proliferating retention type. In removing double cysts the uterus should also be removed by supravaginal hysterectomy, as in the figure.

The most important complication of ovarian tumors is that of torsion, which is said to occur in from 10 to 20 per cent. of cases.

When the ovarian tumor grows to a certain size it rises out of the posterior part of the true pelvis into the anterior part of the false pelvis. During this excursion the pedicle of the tumor is necessarily turned in a spiral manner about 90 degrees. This much torsion does not ordinarily cause symptoms, but under certain mechanical conditions the torsion becomes increased until the blood-vessels of the pedicle are compressed, whereupon symptoms ensue.

The causes of torsion of ovarian cysts are numerous, and are referred to peristaltic movements of the intestines, bodily movements on the part of the patient such as result from strenuous labor, athletic exercises, riding, jars, trauma, etc. One important cause is the unequal growth in different parts of the cyst wall, which encourages a twisting in the location of the tumor. During pregnancy the change in the position of the uterus and the fetal movements of the child are frequent causes of torsion.

[1] Even small corpus luteum or follicular cysts may sometimes rupture, causing an abdominal hemorrhage of a serious nature. According to E. Novak only about 40 such cases have been reported, but the condition is probably often unrecognized. The symptoms are sudden sharp pain, rapid pulse, and general appearance of shock, with abdominal rigidity beginning on the side affected. The diagnosis is difficult to make, simulating as it does either an acute appendicitis or an ectopic pregnancy.

As a rule, if the amount of torsion reaches 180 degrees, symptoms become evident. The pedicle may make two or three complete rotations about its axis, occasionally as many as five or six. The torsion causes first a compression of the veins of the pedicle without interfering with the arterial circulation, and produces a sudden rapid increase in the size of the tumor as a result of venous congestion and greatly increased secretion from the tumor wall. The obstruction of circulation causes a hemorrhage into the lumen of cystic tumors and areas of infarction in the tissues of solid tumors. The pearly, glistening appearance of the surface of the tumor is changed to a dull-brown color, or in different shades to a dark red. The damaged surface of the tumor soon becomes adherent to the intestines and omentum, and if the patient continues to live the adhesions eventually become organized and tenacious.

The clinical appearance of torsion varies in proportion to the acuteness of the condition. If the torsion takes place slowly, and does not exceed a partial compression of the venous circulation of the tumor, there may be only moderate pain without severe constitutional symptoms. The symptoms may continue for some time, usually accompanied by a very evident increase in the size of the tumor. The torsion may even right itself with disappearance of symptoms.

If the torsion is acute, the picture is a stormy one and resembles that of acute peritonitis. The abdomen is rigid and distended and extremely sensitive; the bowels are paralyzed and the pulse is rapid and thread-like. If the tumor does not become septic the attack may pass off, to return again at some future time unless the tumor is removed.

The future course of the tumor is determined somewhat by the adhesions that it forms, which may act either in a deleterious or beneficial way. If the tumor becomes densely adherent to the wall of the intestine, opportunity may be given for the passage of micro-organisms from the lumen of the bowel through the lymph-spaces of the intestinal wall to the cyst, with resultant sepsis and peritonitis. If the adhesions are chiefly to the omentum, the tumor may be endowed with a fresh blood-supply, which will, for a time at least, maintain its life and integrity.

During the puerperium ovarian cysts not only are especially liable to torsion, but when torsion takes place there is especial danger of infection. If the tumor suppurates it may rupture into the abdominal cavity, causing fatal peritonitis, or it may break into the bladder, rectum, or vagina.

The menstrual function is not greatly disturbed by ovarian tumors. Even very large bilateral growths retain enough of the ovarian parenchyma to maintain the menstrual flow, amenorrhea being very rare. Acute torsion of the pedicle usually causes bleeding from the uterus on account of the general pelvic hyperemia.

According to von Franque, pregnancy is interrupted in about 20 per cent. of cases by the presence of ovarian tumors, while childbirth is only exceptionally completely interfered with.

Cancerous cysts of the ovary are usually attended with ascites, and the

chief symptoms are often due to the pressure of the ascitic fluid. If seed metastases are sown extensively on the peritoneum the pain may be varied and severe. When the tumors are malignant the cachexia and wasting are very marked and rapid.

Ovarian tumors occurring in childhood, especially those of the cysto-solid teratoid type, are sometimes associated with precocious sexual development of both the genital and somatic characters (Fusino, Askanazy, Harris). Removal of the tumor arrests the sex development.[1]

## DIAGNOSIS OF OVARIAN TUMORS

Small and moderately sized cysts of the ovary are usually easily distinguished. The smooth, round surface and cystic consistency of the tumor which moves independently of the uterus are, as a rule, unmistakable. If, however, the cyst is very tense it may be difficult to differentiate it from a pedunculated myoma.

If the cyst is intraligamentary or adherent it is often impossible to differentiate it from a sactosalpinx or hydrosalpinx or a tubo-ovaritis. Edematous myomas, and even large organizing pelvic hematoceles from ectopic pregnancy, are sometimes confused with ovarian cysts.

Solid tumors of the ovary, whether pedunculated or not, are difficult to distinguish from myomas of the uterus.

Large ovarian cysts occupying the abdominal cavity are usually easily diagnosed. The lower pole of these cysts can nearly always be felt by the vaginal finger and a fluctuation wave be recognized between the two examining hands. The uterus can be felt either pushed far back in the posterior culdesac, or forced forward above the level of the pubes and to one side of the median line. With the patient on her back the protuberant abdomen is noticeable. A succussion fluid wave can be felt from side to side. In this position a cyst rides upward toward the anterior abdominal wall, while the bowels recede to the flanks. On account of the fluid contents of the cyst the anterior dome of the abdomen is dull to percussion, while the flanks produce the tympanitic note of the underlying intestines. In ascites, on the other hand, the light intestines float on the free fluid contained in the abdominal cavity, and are just under the dome of the abdominal wall, while the fluid settles to the back and flanks. In ascites, therefore, the dome of the abdomen is tympanitic, while the flanks are dull.

There are, however, conditions which present great difficulties in diagnosis. An ovarian cyst combined with ascites, especially if adhesions or metastases are present, is an example. Ascites confined and localized by adhesions, such as is seen in tubercular and cancerous peritonitis, is another condition that is apt to cause confusion.

Large tumors of the kidneys are sometimes mistaken for ovarian growths.

[1] For a bibliography of the subject and report of a case see Rowland H. Harris' article (Surg., Gyn., and Obst., May, 1917).

Careful examination, however, usually reveals their true nature. Tumors of the kidney reach higher up in the hypochondrium than do ovarian tumors, and only very rarely extend low enough in the pelvis to be palpated by the vaginal finger. Most important of all is the examination of the costovertebral angle. Tumors of the kidney large enough to be mistaken for ovarian growths invariably cause a fulness in the triangular space made by the costovertebral angle. This can best be observed with the patient in the sitting position.

Diastasis of the recti muscles is very frequently mistaken by the inexpert for ovarian cyst, especially if the patient has a large, full abdomen. The rapid accumulation of abdominal fat also often evokes a diagnosis of ovarian tumor. Palpation and percussion of the abdomen, coupled with a bimanual examination, readily clear up the difficulty.

## TREATMENT OF OVARIAN TUMORS

It may be said categorically that the treatment of all ovarian tumors is surgical removal. This rule applies even to retention cysts unless they be very small. Retention cysts may of themselves be a source of danger if torsion occurs, or if they become involved in a pelvic inflammation. Moreover, it is impossible to tell by bimanual examination whether a given tumor is a retention cyst or a proliferating growth. Proliferating tumors of the ovary are invariably progressive in their growth, and if not removed eventually cause the death of the patient whether they are malignant or not. They should, therefore, be removed as early as possible.

It is important that the operator should have an understanding of the general pathology of ovarian tumors in order to use proper judgment in the form of operation to be employed. Simple retention cysts, even of large size, if unilateral do not require the removal of the other ovary. In young women retention cysts of moderate size may sometimes be resected so as to leave a small amount of ovarian parenchyma.

Retention cysts complicating pregnancy should always be removed on account of the special danger of torsion and infection. If the cyst is discovered before the third month it is advisable to wait, if possible, until after the third month before operation in order to avoid the chance of causing an abortion. The corpus luteum has been shown to preside over the growth of the fetus for the first two and one-half to three months, its destruction during that period causing the death of the fetus. As the corpus luteum is sometimes included in the ovarian tissue stretched out over the surface of the ovary, an early removal of the cyst is likely to cause an abortion.

In operating on ovarian cysts it is extremely important not to spill the contents of the cyst, as one can never be sure that there may not be a carcinomatous growth on the inner wall, cells from which may be disseminated by the

fluid in the abdominal cavity. It is, therefore, best not to evacuate the cyst before removal unless the exigencies of the case make it absolutely compulsory. This often requires very long incisions, which do no harm if carefully sewed up. It is also important not to rupture adherent cysts during dissection, though it is sometimes unavoidable. It should be remembered that the content of dermoid cysts has a toxic proteolytic action on fresh tissues with which it comes in contact, especially on peritoneal surfaces.

The question of the removal of the other ovary in operating on unilateral ovarian tumors is always a vital one. We have said that the simple retention cysts do not require the removal of the other ovary. This is true also of all the benign tumors, such as fibromata, pseudomucinous cysto-adenomata, par-ovarial cysts, and the dermoids. The serous papillary cystadenomata, whether malignant or not, and all tumors in which malignancy is suspected indicate the removal of both ovaries. As has been stated, when both ovaries are to be taken out, for whatever cause, the uterus should also be removed by supravaginal hysterectomy.

The presence of seed papillomata on the surface of the intestines does not contra-indicate extirpation of the original ovarian tumor, for the patient's life may be greatly prolonged by the operation, and occasionally the seed metastases, even when malignant, sometimes regress and disappear after the removal of the primary growth.

Ascites following operation for papillary and malignant cystadenomata may come on rapidly and fill the abdomen to uncomfortable distention. It is necessary then to tap the contents with a trocar or to evacuate the peritoneal cavity through a small laparotomy incision under an anesthetic. The latter method is preferable, for the removal of the contents can be made much more thorough, especially if they are viscid or gelatinous or contain particles of papillomatous tissue.

Pfannenstiel (Veit III, p. 166) cites 2 cases of Olshausen's which lived six and seven years, and were tapped 76 and 105 times respectively. Pye-Smith tapped a woman 299 times during the course of nine years, while Peaslee broke all records by tapping a patient 665 times during thirteen years. Pfannenstiel also calls attention to the fact that the pleuritic exudate, which sometimes accompanies the ascitic cases of papillary cystoma, usually disappears as completely as the ascites after removal of the main tumor.

## PROGNOSIS OF OVARIAN TUMORS

Operations on uncomplicated ovarian tumors are very successful, the mortality being almost nil. The operation is so simple and attended with so little shock that it can be done with comparative safety on patients even of advanced age. If, however, the tumors are ligamentary or complicated with adhesions the operation may be a very serious one. The prognosis of the benign tumors is almost absolutely good as to recurrence, although it must be borne in mind that some apparently benign growths are microscopically malignant and recur

rapidly. All ovarian tumors should, therefore, receive a rigorous microscopic examination.

The prognosis of malignant cystadenomata is bad, though life may sometimes be prolonged for a surprising period of time. At other times, especially when the cyst contents are spilled in the abdominal cavity, the recurrence is very rapid and destructive.

Removal of ovarian tumors of one side may be followed by the growthn of a similar tumor of the other side, even many years after. This is true of all the ovarian tumors, from retention cysts to carcinomata.

## PAROVARIAN CYSTS

The parovarium is a small glandular strand of tissue lying close to the tube between the leaves of the broad ligament. It can be seen by holding the tube

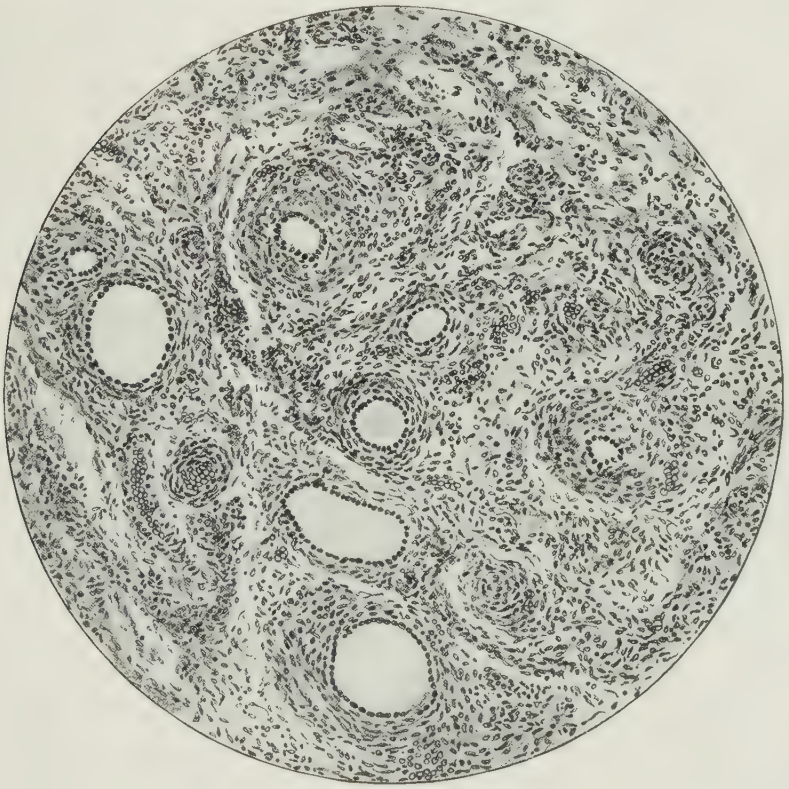

FIG. 181.—PAROVARIUM.

Low power. Several tubules of the parovarium are seen cut in cross-section. They are lined by a single layer of low cells and lie in the broad ligament between the ovary and tube. Cysts may develop from them.

so as to allow the light to pass through the translucent mesosalpinx. It is shaped somewhat like a comb, the back of which is parallel to the tube near the outer segment, while the teeth converge in the direction of the hilum of the ovary.

This structure, made up of small canals, possesses a fibromuscular wall (Gebhard) and minute lumina lined with a low cuboidal ciliated epithelium. The parovarium represents a remnant of the sexual part of the Wolffian body, its function not being known.

The tumors of the parovarium are almost exclusively cysts, and are doubtless formed by an abnormal secretion of the lining epithelium. They are, for the most part, to be regarded as retention cysts and not as proliferating growths. A cystic dilatation of the blind end of the parovarium near the tubal ostium is very common, and becoming pedunculated has the appearance of a cyst of Morgagni. Larger cysts may form between the leaves of the broad ligament

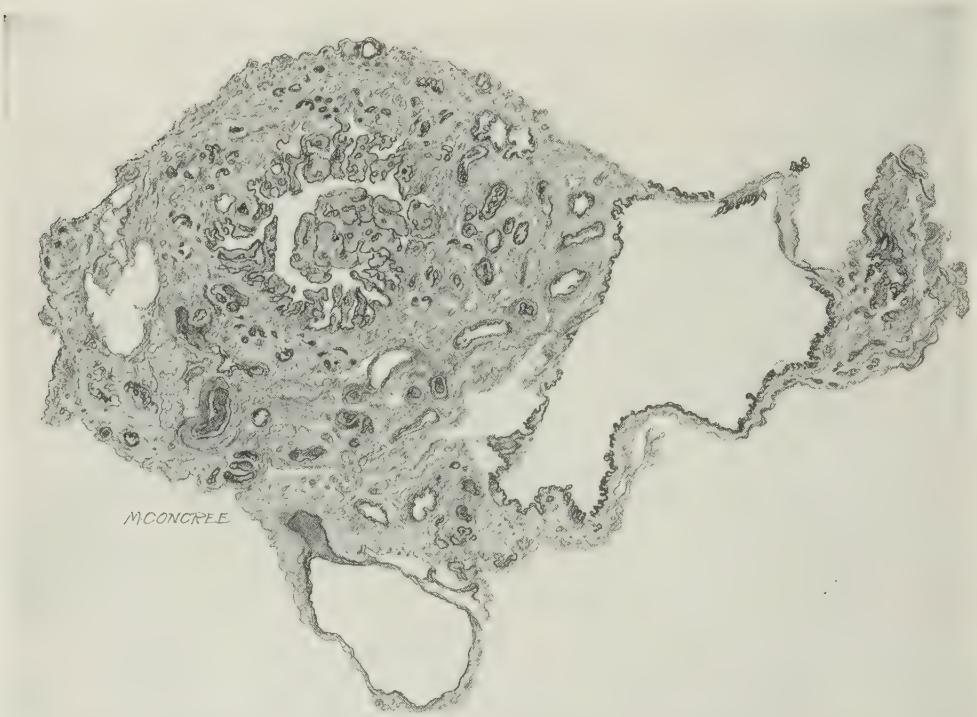


Fig. 182.—Parovarian Cyst.
On the right and below, two early parovarian cysts. On the left and above, section of normal tube.

and sometimes reach a very considerable size. The tube and ovary are stretched out over the surface of the tumor. Parovarian cysts can be distinguished from intraligamentary ovarian cysts by the presence of the ovary attached to the wall. The outer layer of the wall of the tumor is composed of the connective tissue and peritoneal covering of the broad ligament leaf. This layer can be easily stripped from a second well-defined layer which constitutes the real outer wall of the cyst. This wall is made up of connective tissue and smooth muscle-fibers (Gebhard), being lined with a single layer of low ciliated epithelium.

Parovarian cysts are nearly always unilocular, and contain a clear serous fluid, which, as the tumor increases in size, becomes turbid and yellow or brown in color.

The inner surface is often raised in folds that have a papillary appearance, but the cysts rarely if ever become malignant.

Although growing in the broad ligament, the parovarian cysts are often pedunculated and are subject to torsion. They grow slowly and do not produce symptoms unless their pedicles become twisted or unless they grow to a size sufficiently large to cause pressure. They cannot be clinically differentiated from ovarian cysts.

The treatment is extirpation. The small cysts if pedunculated are easily removed. If, however, they have grown downward within the leaves of the broad ligament their extirpation may be attended with much difficulty. Especial care must be taken not to injure the ureters. If it is impossible to remove all of the cyst, portions of the wall may be left behind with safety, as experience has shown that they do not later fill with cystic fluid (Krönig).

Inasmuch as parovarian cysts are, like the retention cysts of the ovary, benign, the prognosis after operation is, so far as recurrence goes, absolutely good.

Other tumors of the parovarium have been described. Veit mentions cases of papillary cystadenoma, fibro-adenoma, adenomyoma, carcinoma, adenosarcoma, and dermoids which are described as having developed in the location of the parovarium.

## TUMORS OF THE TUBES

### CARCINOMA OF THE TUBES

Primary carcinoma of the tubes is a relatively uncommon disease, but is found to be somewhat more frequent than was formerly supposed. In 1910 only 120 cases had been reported in the literature (Veit). Since then numerous cases have been described.

The **etiology** of primary cancer of the tubes is somewhat interesting on account of the fact that at one time it was generally believed that the disease is always referable to a pre-existing chronic inflammatory process. At present this idea has been somewhat modified, for, though most cases are complicated by chronic inflammation, some have been found in which it is absent. It is not unlikely, too, that the inflammation is sometimes a secondary result of the irritating influence of the cancer on the surrounding tissues.

Most of the reported cases have occurred after the menopause, between the ages of fifty and sixty, but the disease may appear earlier, one patient being in her twenty-seventh year.

The original seat of primary cancer of the tube is in the mucous membrane. If the disease appears in the wall of the tube without implicating the mucosa, it must be regarded as secondary to cancer of the uterus or ovary. One case has been described as originating in an accessory tube.

The disease is usually unilateral, occurring bilaterally in about one-third of the reported cases. It originates either in the middle or outer half of the tube, the size varying from that of a pea to the dimensions of a baby's head. The pathologic structure of the tumor is essentially papillary, but infiltrating portions of the carcinomatous tissue may assume an alveolar arrangement. When the disease is in the papillary stage it is difficult to distinguish it from the benign papillomata that sometimes develop in the tubal canal. The general microscopic appearance of cancer of the tube on account of its papillary tendency closely resembles malignant adenoma of the uterus and papillary adenocarcinoma of the ovary. This is not to be wondered at, as the epithelial cells of the endometrium, the tubal mucosa, and the germinal layer of the ovary have a common origin. The surface epithelium in tubal cancer is not ciliated.

The purely papillary form of the disease is usually confined in its growth to the tube, but may metastasize to the regional lymph-glands or to distant parts through the blood-stream. The alveolar form has a greater tendency to infiltrate the tubal wall, and may break through and spread over the peritoneum. It may also extend through the lymph-channels to the postperitoneal lymph-glands.

Both forms have a tendency to metastasize in the ovaries or uterus. Several cases of seed implantation have occurred following operation, one of them being in the abdominal scar.

Cancer of the tube is difficult to diagnose, most cases being discovered incidentally during operations for pelvic inflammation, with which it is usually associated. The prognosis is shown by statistics to be unfavorable. von Franque, in a series of 80 cases operated on, reports a permanent cure in only 5.

The **treatment** of cancer of the tube is very radical, the operation consisting of removal of the uterus and both adnexa and a search for and dissection of infected lymph-glands.

Chorio-epithelioma may occur both primarily and secondarily in the tube. (For further details on this subject, see Chorio-epithelioma.)

Cancer of the tube not infrequently occurs secondarily to papillary cancer of the ovary or adenocarcinoma of the body of the uterus. The similarity in appearance of papillary tubal cancer to both these forms of cancer often makes it difficult to state in which organ the disease was primary.

Cancer of the cervix uteri rarely metastasizes in the tube, only one or two cases having been reported. The tube may take part in a general carcinomatosis of the peritoneum, and may also be secondarily infected from cancer of the intestinal tract.

## OTHER TUMORS OF THE TUBE

In addition to cancer there are numerous other new growths that occur in the tubes, but all are rare. Mucous polyps are sometimes seen, and are thought to be the occasional cause of extra-uterine pregnancy. Papillomata are some-

what more common. They resemble closely the papillary type of tubal carcinoma, from which it is difficult to distinguish them.

Fibromata, fibromyomata, and adenomyomata occur as small nodules in the tube, usually involving the uterine end or the tubal isthmus.

FIG. 183.—ADENOMYOMA OF THE TUBE.

Low power. The tumor consists of gland-like formations usually surrounded by connective tissue like the stroma of the endometrium lying in the muscle. The gland on the left shows this best. The lumen of the tube is obliterated. These tumors occur in the isthmic portion of the tube and are often bilateral.

The adenomyomata of the distal portions of the tubes are probably for the most part transplants from perforating hemorrhagic cysts of the ovaries (see Chocolate Cysts).

The true fibroids of the tube should not be confounded with the adenomyomata of the horns of the uterus, the so-called adenomyositis of the horns, or the related condition of salpingitis isthmica nodosa.

A few cases of lymphangiomata and dermoid cysts of the tube have been

described, and one of so-called fibromyxoma cystosum, the last named probably being of the teratoma group.

Sarcoma and endothelioma are rare tumors of the tube. Small cysts in the subserous tissue are found attached to or in the neighborhood of the tubes, most of them probably representing retention cysts of various embryonal rests. Of these, the most common are the so-called "hydatids of Morgagni," which are probably rests of the Wolffian body. These are small cysts filled with clear serous fluid attached by long slender pedicles to the fimbriæ of the tube, or to the peritoneum of the mesosalpinx near by. They do not exceed a walnut in size and have no pathologic significance. Larger cysts have been described as originating in the subserous tissue of the tube and occurring especially in connection with uterine fibroids.

## TUMORS OF THE ROUND LIGAMENT

Round ligament tumors are comparatively rare. The most recent figures are those of Taussig, who finds 141 cases reported in the literature. These growths may originate either in the intraperitoneal part of the ligament or in that part which lies in the inguinal canal, about 75 per cent. of them springing from the latter location. The intra-abdominal tumors may grow from the ligament with good pedicles, or they may extend between the layers of the broad ligament, for which reason they are often classed with tumors of the pelvic cellular tissue. If the tumor is situated near the internal ring it may grow subperitoneally.

Tumors that originate in the inguinal canal have a tendency to extend down into the vulva. According to Veit, it is probable that most fibroid tumors of the vulva have their origin in the round ligaments. Some tumors that originate in the inguinal canal extend upward between the layers of the abdominal wall. One of our cases developed in one of the round ligament loops that had been attached in the middle line in the performance of a Mayo internal Alexander's operation. The histologic picture of the tumor was that of an adenomyoma, with signs of chronic inflammation in the stroma. In this case it seemed as if the tumor had been excited by trauma or inflammation, and that the process might be properly classified as that of an adenomyositis. Most of the round ligament tumors are small or moderate in size, but they may become as large as a child's head.

Histologically, the round ligament tumors are fibromyomatous in type. Adenomyomata are especially frequent. Cystic and telangiectatic changes are common. A few cases of myosarcoma have been reported and one of dermoid cyst. The origin of the adenomyomata is thought by Cullen to be from rests of the Müllerian ducts. Taussig believes that they are Wolffian in origin.

The recent work of Sampson seems to prove convincingly that the adenomyomata of the round and broad ligaments like those of the posterior culdesac and the rectovaginal septum may be transplants from perforating hemorrhagic cysts of the ovary, the original source of the growth having been the endo-

metrium (see Chocolate Cysts). They may also arise from direct implants of endometrium discharged from the tubes.

The intra-abdominal tumors are slow growing and ordinarily give no symptoms unless they become exceptionally large. The extra-abdominal growths in the inguinal canal become noticeable as a lump in the groin and are frequently regarded as a hernia. They are sometimes associated with true hernias.

The **treatment** of round ligament tumors is removal if they give symptoms or if they are incidentally encountered during a pelvic operation.

## TUMORS OF THE PELVIC CONNECTIVE TISSUE[1]

Most of the retro- or subperitoneal tumors of the pelvis have their origin in the connective tissue contained between the leaves of the broad ligaments. Here can be found numerous tissue elements which may serve as starting-points for cystic or solid tumors—embryonal rests, such as the parovarium and Gärtner's ducts, smooth muscle-fibers, lymph- and blood-vessels, and the loose cellular connective tissue. In addition to the tumors that grow primarily from the subperitoneal tissue are those that extend into the intraligamentary space from an original seat in the uterus or ovaries. Freund classifies tumors of the pelvic connective tissue in the following way:

I. New growths primary in the pelvic connective tissue.
- (*a*) Mesodermic tumors.
  1. Fibroma (fibromyoma).
  2. Sarcoma.
  3. Lipoma.
- (*b*) Dermoid cysts.
- (*c*) Parenchymatous cysts (resembling the papillary serous cystadenomata of the ovary).[2]

II. New growths which arise from embryonal elements in the broad ligaments.
- (*a*) Parovarial cysts.
- (*b*) Cysts and solid tumors of Gärtner's duct.
- (*c*) Dislocated adrenal tissue.
- (*d*) Cysts from rests of the primary kidney (Wolffian body).

III. New growths which develop in neighboring organs and extend into the broad ligaments.
- (*a*) Uterus (subserous intraligamentary fibroids).
- (*b*) Ovaries (cysts or solid tumors).

IV. New growths which extend or metastasize into the pelvic connective tissue.
- Carcinoma of uterus.
- Carcinoma of rectum.
- Carcinoma of bladder.
- Carcinoma of ovaries.

We are at present interested only in the first group of the classification, the other groups having already been discussed in their proper places.

The primary retroperitoneal tumors may be located anywhere in the subserous cellular space that reaches from deep in the pelvis up to the region of the kidneys. Those that originate between the free leaves of the broad ligament,

[1] Principal authority, Freund (in Veit, Vol. I).

[2] This item has been added to Freund's classification as a result of a tumor reported by the author on p. 460.

near the round ligaments, occupy a position in the pelvis similar to the tumors of the internal genitalia, from which they cannot readily be distinguished by bimanual examination. Tumors that develop deep in the pelvic connective tissue usually grow downward in the paravaginal and pararectal space, and may even extend through the ischiadic foramen into the gluteal region. If they have their origin in the tissue posterior to the cecum or sigmoid flexure, they tend to grow upward toward the kidney region.

These neoplasms often attain an enormous size, and when they develop in certain situations in the pelvis cause extraordinary dislocations of the pelvic organs, especially of the bladder, the vertex of which may be forced high up on the abdominal wall or far to one side.

In one case of retroperitoneal sarcoma that came to the notice of the author the bladder was drawn out into a spiral tube of such length that the vertex could not be reached by the end of a male rubber catheter inserted in the urethra.

Most of these tumors grow slowly at first, and do not cause symptoms until they are large enough to produce pressure on important organs. Interference with the function of the bladder is apt to be the first sign of trouble, with retention or incontinence of urine. Pressure on the ureters may cause hydronephrosis. Freund describes a form of "chronic uremia" with general bodily disturbances consequent on the long and slowly increasing pressure interference of the ureters. Large tumors situated deep in the pelvis, especially those of the solid type, in the course of time compress the rectum and may completely prevent the passage of fecal matter.

Interference with the pelvic circulation causes enormous dilatation of the veins and constitutes a serious danger to be reckoned with in enucleating the tumors.

Pressure on the nerve plexuses of the pelvis sufficient to cause symptoms is a comparatively late development and may produce pain of the severest type.

**Fibromyomata** originate in the smooth muscle-fibers with which the broad and round ligaments are abundantly supplied. These tumors, developing as they do between the leaves of the broad ligament, are to be distinguished from the intraligamentary fibroids of uterine origin by the absence of myomatous tissue connection between them and the uterus. Uterine fibroids that grow into the broad ligament never separate from the uterine wall, as do certain free pedunculated fibroids (parasitic myoma), so that if there is no myomatous connection between the ligamentary fibroid and the uterus it must be regarded as having an independent origin.

The intraligamentary fibromyomata grow very slowly, as a rule, unless they undergo some form of degeneration, when they may take on a sudden and rapid development. If they originate high in the broad ligament they may become pedunculated. If they start deeper in the pelvis they may either extend upward toward the region of the cecum or sigmoid, or downward toward the ischiadic foramen.

Fibromata of the round ligament may develop intra- or extraperitoneally or within the inguinal canal (Kelly). The infundibulopelvic ligament may also be the seat of fibromatous growth.

Fibroid tumors of the pelvic connective tissue are subject to the same regressive and degenerative changes characteristic of uterine myomas, including complications from infection, suppuration, and necrosis.

**Sarcoma** of the pelvic connective tissue may start as an essentially malignant tumor, but more commonly it represents the degeneration of a fibroma or fibromyoma. The sarcomatous change in a fibroma is signified by rapid growth of the tumor or by the sudden onset of pressure symptoms. The prognosis is bad, for not only is the removal of the tumor difficult and dangerous, but there is great probability of early recurrence.

Trout and Meekins in a recent report have collected from the literature 108 cases of retroperitoneal sarcoma. To these we can add 2 cases from our personal experience. In the first case the sarcoma originated in the posterior wall of the abdomen. The patient died after two years, of recurrence, three operations having been performed. In the second case the sarcoma originated in the anterolateral wall of the pelvis. The tumor was very large and extensively degenerated. Operation was performed and the patient is now in excellent health after six years.

For inoperable cases Burnam recommends enormous doses of radium.

**Lipoma.**—Retroperitoneal lipomata starting in the connective tissue of the pelvis are very rare. More common are those that originate in the mesocolic region, though these tumors may extend into the pelvic subserous tissue. The growths have the form either of pure lipomatous or myxomatous tissue. They grow diffusely in the subserous cellular tissue and may reach enormous dimensions, reaching from the pelvis to the kidneys. Some of them undergo sarcomatous degeneration and recur after removal. Recurrences also sometimes take place after extirpation of tumors that are microscopically entirely benign.

**Dermoids.**—The most interesting of the retroperitoneal tumors are the dermoids. These originate in the subserous cellular tissue and are entirely independent of the ovaries, though they possess the same characteristics of structure as do the ovarian dermoids. The histogenesis of extragenital dermoids is at present a matter of speculation, numerous theories having been suggested. By the so-called blastomere theory it is thought that at the earliest divisions of the impregnated egg one of the original cell elements (blastomere) becomes isolated and exists as a fetal inclusion, or as a fetus within a fetus. Some regard the tumors as springing from misplaced germ-cells which develop parthenogenetically, while others believe that they grow from accessory ovarian tissue, on the ground that supernumerary ovaries with germ-cells have been found within the leaves of the broad ligament. (See also Dermoids of the Ovary.)

Another theory is that the extragenital dermoids represent defective twin development.

These cysts have a tendency to grow downward toward the perineum, pushing the vagina, uterus, and rectum to one side, and may eventually emerge

from the ischiadic fossa in the gluteal region and appear under the skin of the buttocks. The size of the tumors described varies from that of a pigeon's egg up to a baby's head (Freund).

The cysts are usually oval in shape, though they are somewhat flaccid and adapt themselves to the compressed quarters in which they lie. The structure of the retroperitoneal dermoids is, in general, like that of the dermoids that originate in the ovaries, except that those which develop *below the pelvic diaphragm* usually exhibit the elements of *only one germinal layer*. The contents usually consist of characteristic sebaceous or atheromatous material with hair and bone, but these may be absent and the fluid may be of a non-distinctive nature.

The growth of retroperitoneal dermoids is extraordinarily slow, and they give no symptoms unless they become infected or until they become large enough to cause pressure disturbances.

The prognosis is good if they can be removed before they become too large or too adherent.

**Cystadenomata.**—Tumors resembling the serous cystadenomata of the ovary are sometimes found originating in regions distant from the ovary. A case occurring in the author's practice is an example. In this case there were two tumors, one on the posterior pelvic wall just below the brim of the pelvis, and the other between the peritoneal leaves of the mesentery of the descending colon near the splenic flexure. Both tumors resembled exactly the papillary cystadenomata of the ovary.

The **treatment** of retroperitoneal pelvic tumors is always surgical removal if possible, because of the danger of malignant degeneration and the inevitable pressure disturbances that are sure to ensue sooner or later even in the benign growths.

If the tumors are large, their removal tests the skill of the surgeon to the utmost. If the tumor is attacked by the abdominal route an incision is made through the broad ligament, and then, at some point that is free of blood-vessels, the outer capsule of the tumor is divided and the plane of cleavage is found. When this plane has been properly located the tumor can be enucleated gradually by blunt dissection with the fingers. By this method of decortication serious bleeding can be avoided, and there is less danger of injuring the rectum and bladder. In removing dermoid cysts it is advisable to extirpate them if possible without rupturing the wall, for the contents are very proteolytic and predispose the surrounding tissues to infection.

The point of attack for the cysts must be determined by the location of the tumor, and the incision may be abdominal, prevesical, perineal, retro-anal, or parasacral.

## TUMORS OF THE BLADDER

The most frequent and the most important tumor of the bladder is the papilloma. The majority of these tumors are well pedunculated and have a

characteristic villous surface. Some, however, possess broad sessile bases, while the papillary nature of the surface may be disguised by a gluing together of the villi from inflammatory processes.

The papillomata vary in size from that less than a pea to that of a man's fist. They may be either solitary or multiple, or even disseminated over the entire surface of the bladder mucous membrane. They occur most commonly on the floor of the bladder, but are not infrequently seen suspended from the vertex.

The microscopic appearance is that of characteristic papillary growth—villous processes with a vascular connective-tissue stalk covered with numerous layers of epithelium, bespeaking the origin of the process from the bladder epithelium. Some of the tumors are solid and fibrous, while others have long delicate papillæ like water plants. Incrustations of urinary salts sometimes cover the tumor as a result of necrosis.

It is often difficult to tell, even from microscopic examination of these tumors, whether they are benign or malignant. There seems to be no doubt that some of the growths are malignant from the beginning, and also that some of the papillomata, though originating as benign tumors, later degenerate into carcinomatous activity. It is the part of wisdom to regard all papillomata of the bladder as suspicious, and to remove them as quickly and completely as possible.

## CARCINOMA OF BLADDER

Carcinoma of the bladder occurs in the forms of scirrhous, medullary, and cancroid squamous epithelial growths. The scirrhous variety is relatively more favorable than the others. The squamous form is said to develop from the leukoplactic changes of a chronic cystitis. Carcinoma of the bladder, though sometimes at first papillary in form, tends to spread out irregularly through the wall, with ultimate ulceration and infiltration of the paracystic tissue. Metastases are comparatively late and take place in the regional pelvic lymph-glands.

*Secondary carcinoma* of the bladder comes as a direct extension from cancer of the cervix or vagina, but occurs later than one would expect from the close proximity of the primarily diseased organs. Invasion of the bladder wall bespeaks an advanced stage of cancer of the cervix or vagina, usually beyond the point of operability. As the disease progresses the vesicovaginal septum may be eaten away, with consequent fistula formation.

Other tumors of the bladder are of relative infrequency. A form of adenoma with infiltrating tendencies has been described. Cases of sarcoma have been reported, mostly in children. There have been a few cases of dermoid cysts developing in the wall of the bladder. These are to be distinguished from the ovarian dermoids that occasionally become attached to and rupture into the bladder. Other rare tumors of the bladder are myxoma, fibromyxoma, and fibroma. Small cysts of the mucosa are the result of chronic inflammatory changes.

**Symptoms.**—The first sign of a bladder tumor is usually bleeding without previous symptoms, which may suddenly cease and not appear again until long after. The bleeding may be slight or profuse, and may appear spontaneously or as the result of some trauma. It is at first intermittent, but in the course of time, as the tumor grows, the hemorrhages are more constant and often result in severe secondary anemia.

The tumors are at first uncomplicated with cystitis, but when ulceration has occurred, cystitis, often of a severe grade, ensues.

The **treatment** of vesical tumors is immediate removal. For small single or multiple papillomata the high-frequency current is extremely efficacious. For the larger tumors, and those that from their appearance suggest malignancy, extirpation by the suprapubic route is the best course. For the more extensive growths, where greater exposure of the bladder is required, the transperitoneal route is available and comparatively safe.

Total extirpation of the bladder, with implantation of the ureters in the bowel, is an operation of last resort. The mortality of this operation is high, while an ascending infection of the ureters and kidneys is almost inevitable.

## VESICAL CALCULUS

Stone in the bladder is far less common in women than in men partly because the exciting causes, so far as they relate to cystitis, are more easily healed in women, and partly because the female urethra more readily allows the passage of small vesical or renal concretions before they have a chance to reach a size of clinical importance.

Vesical calculi form by the crystallization of different urinary salts, and may originate in the bladder itself or be passed into the bladder from the kidney. They are composed chiefly of ammonium urates, phosphates, uric acid, oxalates, carbonates, cystin, and xanthin, the larger stones having usually a mixed composition, which gives them a distinct lamellated structure.

The primary etiologic factor in the formation of urinary calculi is thought to be some obstruction or stagnation of the urine. Cystitis and ammoniacal conditions are especially favorable. Concretions always form about foreign bodies which are not infrequently found in the bladder of women. These consist of small objects, such as hair-pins, pencils, nails, etc., which, being used for purposes of abortion or masturbation, accidentally slip through the urethra into the bladder. Other foreign bodies that are found in the bladder as nuclei of calculi are pieces of cotton, broken bits of catheter, or other instruments used by physicians in treatment. One of the commonest starting-points for a concretion is the so-called "wandering" stitch or unabsorbable ligature that has been placed in the bladder wall during a previous pelvic operation.

The real vesical calculi move freely in the bladder unless they are impacted in diverticula, a favorite location, or are fixed in the urethral canal. They

may exist for a considerable period without causing symptoms, but erosion of the wall, with bleeding and subsequent infection, are sure to take place in time. The symptoms, then, are of a severe cystitis with hematuria.

The **diagnosis** is not usually difficult. Many times the stone can be felt by bimanual examination, while a sound will give the characteristic metallic click unless the stone is so embedded that the instrument cannot come in contact with it. The diagnosis is established by the cystoscope and by the *x*-ray.

**Treatment.**—Small stones and foreign bodies can be drawn out through the urethra with the help of the cystoscope, but great care should be taken not to injure the vesical sphincter or lacerate the urethral mucous membrane. By means of the lithotrite, a powerful crushing instrument, many stones can be broken and removed piece by piece, or crushed, and the small bits washed out of the bladder by an irrigating and evacuating apparatus. If the stone is so large or hard that these means are not feasible, it can be removed through a vesicovaginal opening, the wound being left open for drainage if there is present a severe cystitis. A large stone may also be removed through a suprapubic extraperitoneal incision.

## TUMORS OF THE RECTUM

### CANCER OF THE RECTUM

Of the malignant growths of the rectum, carcinoma is by far the most common. The type of cancer most frequently found is the adenocarcinoma, which repeats in its structure the rectal mucous membrane from which it is sometimes difficult to distinguish it, excepting by its tendency to penetrate into the deeper layers of the rectal wall. Colloid carcinomata, and occasionally the medullary and scirrhous types, may also occur. They grow most commonly at the lower end of the gut, just within the anus or at the junction of the rectum with the sigmoid, though they may originate at any point of the rectal canal. Constituting as they do pelvic tumors which can be palpated by vagina, they come, to a certain extent, within the sphere of gynecology. They may occupy only limited portions of the rectal wall or they may extend around the entire circumference of the tube in the manner of the inflammatory strictures (*q. v.*). They metastasize to the regional lymph-glands, and may spread by direct extension to various parts of the pelvis involving the pelvic connective tissue. Extension into the vaginal mucous membrane sometimes takes place. In the later stages distant metastases are sent to the liver and lungs.

**Symptoms.**—The chief symptom of cancer of the rectum is bleeding, due to the tendency which the tumor has of superficial necrosis and ulceration. Rectal pain is a comparatively early symptom. There is also a marked tendency to constrict the bowel, especially in the annular form, with dilatation of the

bowel above and retention of feces and the products of necrosis of the tumor. This results in severe auto-intoxication and cachexia.

The **diagnosis** of cancer of the rectum is not difficult. In most cases the tumor mass can be felt both by vaginal and rectal examination and can be seen through the proctoscope. With the aid of a proctoscope, if the tumor is not situated too high, a specimen can be removed for microscopic examination. A differential diagnosis between inflammatory stricture and the annular form of carcinoma may be quite difficult. In this the general constitutional symptoms are often of assistance, for, as a rule, the general effect of inflammatory stricture on the health of the patient is much less severe than that from cancer.

The **prognosis** of cancer of the rectum is, in general, rather bad, but it is much better in women than in man, due to the fact that the rectum is less adherent in the female pelvis, and hence offers a better chance for surgical removal of the disease.

The **treatment** of cancer of the rectum is radical removal if the disease is not too far advanced. Radium seems to be less efficacious in this disease than in cancer of the cervix. The nature of the operation depends on the location of the tumor mass. An early cancer situated just above the anus, which has not penetrated the deeper layers, can sometimes be removed through a dilated sphincter by resecting the gut in the manner of Whitehead's operation and suturing the upper end to the anal membrane. Cases as favorable as this are not often seen. Low cancer of the rectum may sometimes be removed through an incision starting from the vagina through the perineum and into the sphincter muscle. If necessary the sphincter may be cut both anteriorly and posteriorly, and the incision carried back to the coccyx (Abbe). The rectum can then be dissected out, including, if necessary, some of the vaginal wall. In this way several inches of the gut may be resected and the upper end brought down and sutured to the anus. The cut ends of the sphincter are sutured and the wound of the perineum and vagina closed by the usual plastic methods. In this way control of the bowels is maintained. Abbe recommeneds an inguinal colostomy as a preliminary to this operation. Only a few cases are seen which are early enough for a cure by this method. Occasionally a cancer of the rectum near the junction of the sigmoid can be resected and the bowel ends united by end-to-end anastomosis. The author has one such case well at the end of five years. For the extensive cases more radical measures are necessary. These include the establishment of an artificial anus and a dissection of the rectum either by the abdominal or perineal route, or by a combination of both, or by the removal of the sacrum according to the method recommended by Kraske.

Other malignant tumors of the rectum are epitheliomata which grow inward from the anal region, sarcomata, and endotheliomata, all of which are rare tumors.

The treatment of these tumors is the same as that for cancer.

## ADENOMA

Adenomata of the rectum are benign new growths springing from the rectal mucous membrane. They may be sessile or pedunculated, in which latter case they constitute the familiar rectal polypi, the most common of benign tumors of the rectum. These polypi may be single or multiple, and sometimes occur in such numbers and are so closely grouped that the term "polyposis" has been applied to the condition. The rectal polyp repeats histologically the rectal mucous membrane from which it originates, except that there is usually a marked hyperplasia of the glandular structure which occasionally becomes cystic. Rectal polypi vary in size from that of a pea to a walnut, and tend, as a rule, to remain benign in character. They are, however, sometimes the starting-point for adenocarcinoma.

Some of the rectal polypi are fibrous in structure and represent probably a growth from the rectal submucosa.

The polypoid growths of the rectum cause bleeding and sometimes tenesmus. They are diagnosed without difficulty and are best treated by surgical removal. The rare condition of polyposis is a grave disease, the treatment of which must be determined by the exigencies of the case.

## PROLAPSE OF THE RECTUM

Prolapse of the rectum is a disease that occurs most frequently in childhood, but is sometimes seen in the adult. True prolapse of the rectum must be distinguished from prolapse of the mucous membrane, which is a common accompaniment of hemorrhoids. In the latter case, the mucous membrane slips away from its loose attachment to the muscular layer of the rectal wall and protrudes from the anal orifice. The extent of prolapse of this kind is necessarily limited, seldom more than 1 inch of the rectal mucosa coming down. This form of prolapse has been termed "incomplete prolapse" and "prolapsus ani." It may sometimes be the preliminary stage of a later true prolapse of the rectum.

Prolapse of the rectum, in its strictest sense, relates to a turning inside out of the entire rectum, including all the layers of the wall. The descent of the rectum is due to a loss of the somewhat loose connective-tissue attachment which it has to the hollow of the sacrum. In children, the curve of the sacrum being flatter than in the adult and the sacral attachment being more delicate, prolapse after prolonged straining or depleting diseases is comparatively common. In the adult, on the other hand, the more pronounced curve of the pelvic outlet and the greater development of the protecting levator ani muscles makes the disease uncommon. In gynecologic practice the condition may be seen at any age, but it is said to be more common in elderly women in whom there is much perineal and sphincteric relaxation. Most of the cases we have seen have been in comparatively young women.

The characteristic appearance of prolapse of the rectum is that of a rosette which extrudes with the act of defecation. The size of the extruded mass is, as a rule, surprisingly large. It is usually not painful at first, but, as the prolapse recurs more and more frequently and drying and ulceration of the mucous membrane takes place, the condition may become very distressing. In the more advanced cases there is frequently a hernia of Douglas' pouch, containing intestines situated in the *anterior* part of the prolapsed mass. This, as Moschowitz has pointed out, represents the type of "sliding hernia."

The **treatment** should always at first be palliative and supportive. Operation is rarely necessary in children, a cure being usually possible by so strapping the buttocks as to prevent extrusion and at the same time allow for defecation. In the adult the same procedure can be carried out unless there is great relaxation of the parts surrounding the anus.

Some advocate the use of a vulcanite plug held in place by a T-bandage and pad, and claim by this method that in time the natural tonicity of the supporting structures asserts itself sufficiently to maintain the rectum in position. Cold and mildly astringent enemas may be tried at first.

If the case is intractable, one must resort to surgical methods, which consist either of linear cauterization or of various cutting operations. Linear cauterization, performed under anesthesia, is done by drawing several times a blunt-pointed Paquelin cautery at dull red heat along the mucous membrane in the longitudinal axis. The cautery should sere only the mucous membrane and not be allowed to burn deeply into the muscular tissue. Five or six lines should be made. This procedure sets up an inflammatory reaction, which after healing serves to prevent the descensus of the bowel. This method can also be used for prolapse of the rectal mucous membrane.

The surgical operations best adapted to the cure of prolapse are described in detail in the section on Operative Technic. They consist of amputation of the prolapsed rectum, fixation of the rectum to the sacrum, and intra-abdominal suspension.

## HEMORRHOIDS

Hemorrhoids constitute a varicose condition of the hemorrhoidal veins. They have been classified as to form, location, and consistency in numerous different ways, but the description by Pennington is especially practical. He calls attention to the fact that hemorrhoids are formed on the inner side of the two cones that coalesce in embryonal life to form the anal canal. The upper cone represents the end of the hindgut (rectum), and is lined with intestinal mucous membrane and nourished by the superior hemorrhoidal vessels. The lower cone is the proctodeum and corresponds to the anal dimple (Fig. 184). It is lined with squamous epithelium and is supplied by the inferior hemorrhoidal vessels. In embryonal life the apices of these two cones unite at the pectinate line, failure of union being the cause of imperforate anus. Pennington dis-

tinguishes hemorrhoids according to their location in relation to the point of coalescence of the two cones. Internal hemorrhoids represent a dilatation of the superior hemorrhoidal veins in the upper cone, while external hemorrhoids result from distention of the inferior hemorrhoidal veins of the lower cone. Interno-external hemorrhoids are located partly within both cones, and are the result of a varicose condition of both superior and inferior sets of veins.

Internal hemorrhoids always contain fluid blood, the interno-external type contain both fluid and clotted blood, while the external hemorrhoid either contains a clot (thrombotic pile) or is a mere tab of skin which represents the remnant of an old hemorrhoid.

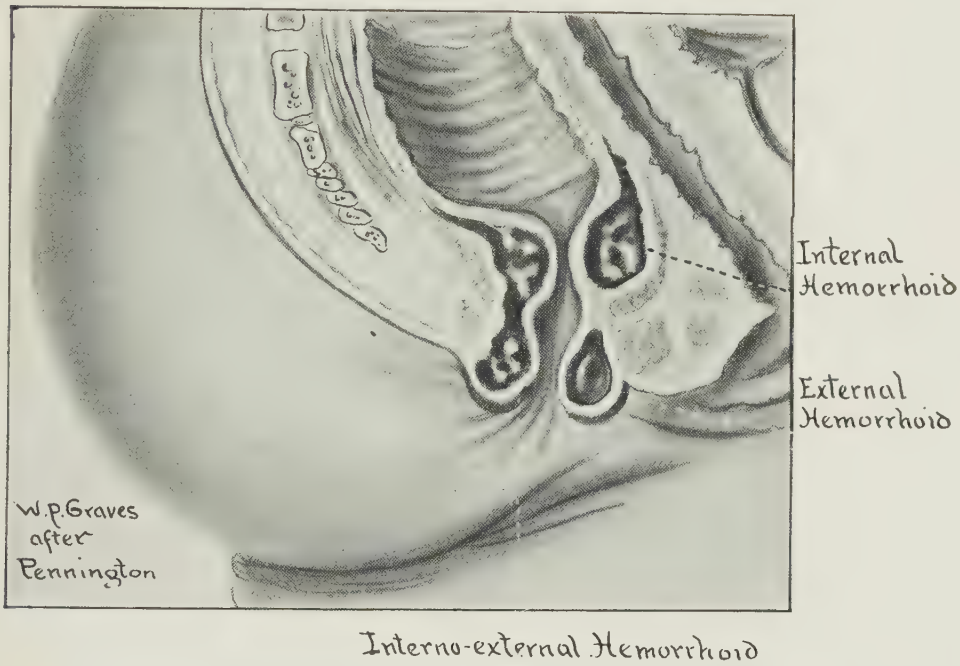


FIG. 184.—HEMORRHOIDS.

The three types of hemorrhoids are shown—internal, external, and interno-external. (After Pennington.)

The **causes** of piles are extraordinarily numerous. Some individuals inherit a predisposition to piles in a congenital deficiency in the supporting power of their tissues. Very important are those conditions which cause stasis or obstruction of the portal system, in which a long column of blood is unsupported by valves. The pregnant uterus and tumors that exert pressure on the mesenteric vessels or some part of the portal system are examples. Abdominal pressure exerts an obstructing influence on the portal circulation, and, therefore, the labors of childbirth constitute a frequent cause of hemorrhoids which, however, may exist only temporarily. Chronic diseases of the heart, lungs, and liver are frequently associated with hemorrhoids. Chronic constipation and

enteroptosis are other factors. Retroversion of the uterus and pressure on the rectum by pelvic tumors are usually mentioned in the etiology, but probably do not play a very important rôle.

A very frequent cause of hemorrhoids, not always sufficiently appreciated, is the lacerated or relaxed perineum. Here the support of the levator ani muscles, which is of importance to the proper circulation of the anal region, is lost or made incomplete by the separation and retraction of the two muscles. The importance of the relaxed perineum in the causation of hemorrhoids is evidenced by the regularity with which hemorrhoidal symptoms are relieved following perineoplastic operations.

External hemorrhoids become inflamed easily, in which case they are swollen and edematous and are very painful. Itching is sometimes a distressing symptom. In individuals with little resistance the inflammation may be extensive and even involve the veins of the leg. Skin-tabs do not ordinarily give much discomfort, but they are liable to recurrences of thrombosis or inflammation. Internal hemorrhoids are liable to fissure and especially to bleeding. The bleeding may be only slight in amount and give little trouble, or it may be serious enough to cause grave anemia or even fatal hemorrhages.

The diagnosis of external hemorrhoids is a simple matter. For internal hemorrhoids a digital examination should always be made, to rule out the possibility of stricture, cancer, or ulceration of the rectum. Internal hemorrhoids cannot easily be felt by the examining finger and should be subjected to inspection. This can best be done by placing the patient in the Sims position. With the right forefinger hooked into the perineum, and pressing strongly on the rectal wall toward the anus, the entire anal canal is easily rolled out and completely exposed to view. The maneuver is more successful if the patient at the same time exerts abdominal pressure as in the act of defecation.

The **treatment** of hemorrhoids comprises palliative and operative measures. Palliative treatment does not effect a cure, but serves to alleviate distressing symptoms during an "attack."

A restricted diet and the use of cathartics that produce soft unirritating stools are of first importance. Local applications in the form of ointments (Ung. gallæ et opii, hamamelis, etc.) are useful if the ointment is applied so that it comes in contact with the mucous surface inside the sphincter. Hamamelis suppositories are excellent for the average case. Inflamed piles are best treated by rest and hot fomentations, frequently changed and held snugly against the anus by a T-bandage. Morphin suppositories may be necessary for the pain in severe cases. Strangulated piles must be reduced, if necessary under an anesthetic.

In considering radical treatment for hemorrhoids it must be remembered that operations for this disease are not without their drawbacks. Dangerous hemorrhage, sepsis, even fatal embolism have been known to occur. If the operation is done coincidently with an abdominal section the convalescence

may be greatly complicated by the inability to use the rectum for enemata if there is stasis of the bowels.

The mere existence of hemorrhoids does not indicate an operation. Continued symptoms do. In the case of hemorrhoids dependent on perineal relaxation the plastic operation usually cures the hemorrhoids.

The methods of operating on hemorrhoids are numerous, and may be divided in two classes: (1) Those that depend for their efficacy on the creation of a slough and healing by granulation, and (2) those that depend on clean removal. In the first class are included such procedures as crushing, application of strong nitric acid, injections of carbolic acid, and the classical clamp and cautery. Operations of the second class include dissection, ligature, and the annular excision commonly known as Whitehead's operation.

Operations of the first class are rarely used now, as they have little to recommend them. They are apt to be followed by bleeding, swelling, and fissures. Operations of the second class are described in the section on Operative Technic (see page 869), and are the procedures of choice.

## Defects of Development

**Embryologic Development of the Genital Organs.**—A knowledge of the main processes that take place in the fetal development of the pelvic organs is necessary for an understanding of certain malformations and tumor growths.

At about the end of the fourth week of embryonal life in the human the Wolffian bodies are formed along the sides in the lower third of the body, reaching upward as far as the point where later the diaphragm develops and extending downward in the form of a duct (Wolffian duct) to the cloaca.

In the fifth to the sixth week of embryonal life there appear, just inside of the Wolffian bodies, the elements of the genital glands, covered with a special epithelial layer, the so-called "germinal epithelium," which contains here and there cells rich in protoplasm, the primary eggs.

Coincidently with the development of the genital glands there are seen, situated externally to the Wolffian bodies, two ducts which extend to the urogenital sinus (Fig. 185). These are the Müllerian ducts. From the primary genital glands are developed the ovaries in woman, while from the Müllerian ducts is developed the entire genital tract to the vaginal introitus.

The Müllerian ducts are at first solid, and extend to the urogenital sinus as separate, unfused structures. Malformations of the genital tract always imply some disturbance in the proper development of these two ducts, and involve either an atresia of one or both ducts or a lack of fusion. If the development of Müller's ducts proceeds normally they run close together in their lower half, eventually becoming merged into one structure. The upper parts of this structure (the future uterus) first acquire lumens lined with a single layer of cylinder epithelium, while the lower section of the fused portion (the future vagina) remains solid for a somewhat longer period, being composed of large cells rich in protoplasm. Gradually, however, this lower part also acquires a lumen and becomes the vagina. The fusion of the lower half of Müller's ducts is completed in the ninth fetal week. At this period the vagina is merged into a single structure, *but is still solid.* The uterus, on the other hand, is *separated into two hollow compartments,* this double construction remaining until the fourth or fifth month, when the uterus and vagina acquire a single communicating lumen, which shows no signs of the former double formation, except a slight depression at the fundus where the partition ended. It is important to keep clearly in mind this particular part of the embryology of the genital tract in order to comprehend the various types of maldevelopment of the uterus.

At about the beginning of the fifth month the uterus becomes differentiated from the vagina by the formation of the vaginal portion (cervix). At the end

of the fifth month the fundus of the uterus rounds out, so that all appearance of the former double character of the uterine body disappears. The wall of the uterus acquires muscle-fibers at about the fifth month, at which time also the hymen appears as a special differentiation of the lower vaginal segment. At birth the uterine body is small, thin walled, and insignificant in comparison with the cervix.

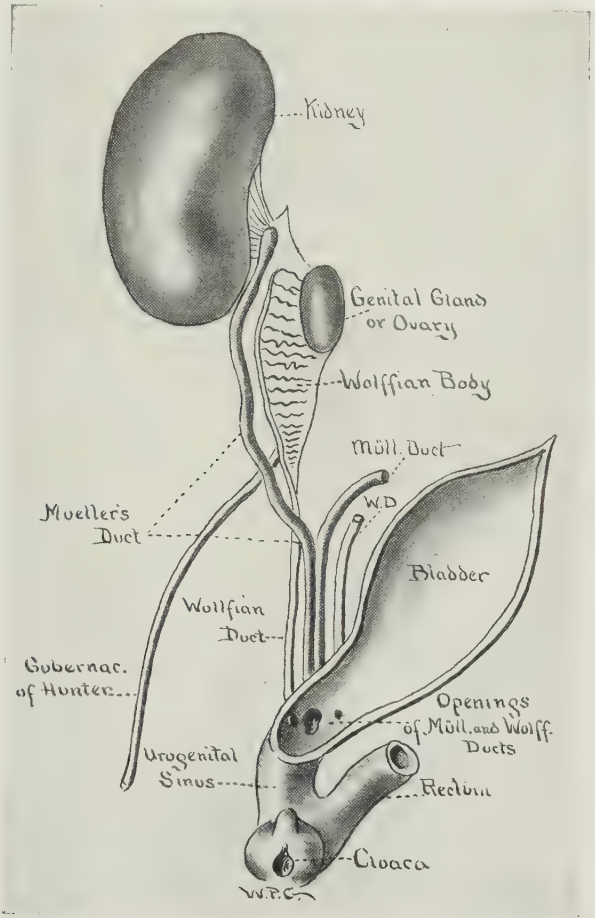


FIG. 185.—DIAGRAM SHOWING THE RELATIONSHIP OF THE MÜLLERIAN AND WOLFFIAN DUCTS AND THEIR OPENINGS INTO THE UROGENITAL SINUS.

Even in the earliest periods can be noted a difference in the character of the epithelium in different segments of the Müllerian ducts. The upper portions from which the tubes and uterus are formed first become hollow, and are lined with a simple cylinder epithelium, while the vaginal part, as was stated above, remains until a later period a solid structure, filled with large cuboidal epithelial cells. The layer of epithelium which lines the upper parts does not become ciliated until extra-uterine life.

The mucous membrane of the uterine body is in the embryo very little

differentiated from that of the cervix, while the branching folds, which characterize the cervix in the adult (arbor vitæ), are, in the embryo and child, continued to the fundus of the uterus (Fig. 186). The establishment of secreting glands in the mucosa of the uterus is a late development, there being no definite period for their appearance. It is said that in some instances there is a full equipment of glands at birth, while in others they do not appear until the child is ten or twelve years old. The glands of the cervix develop first.

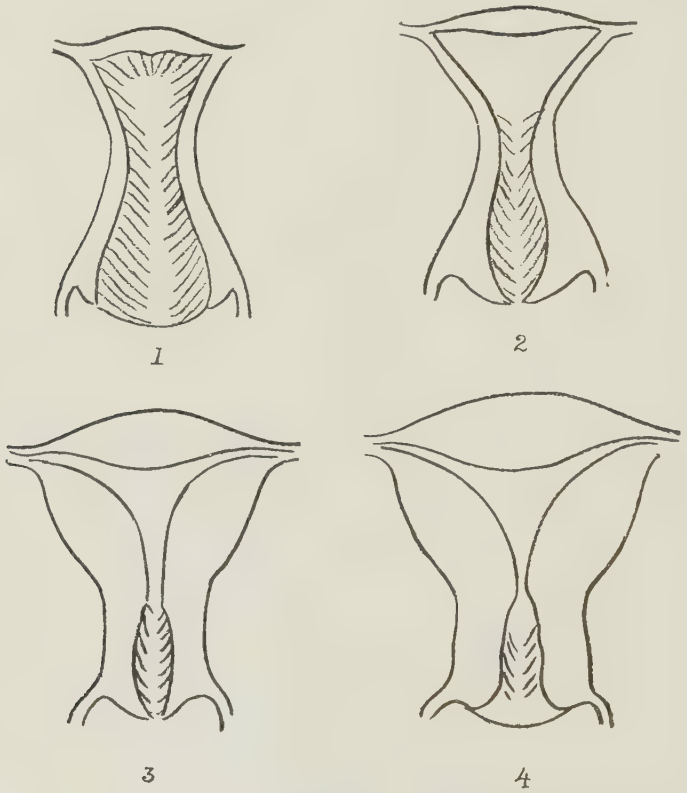


Fig. 186.—Development of the Uterus.

1. Uterus of newborn child. The cervix shows much greater development than the body. The folds of the arbor vitæ reach from the cervix to the top of the uterine canal. 2. Uterus of a seven-year-old child. The body is equal in development to that of the cervix. The folds of the arbor vitæ reach just beyond the internal os. 3. Uterus of a mature virgin. The development of the body excels that of the cervix. The folds of the arbor vitæ reach only to the internal os. 4. Uterus of a woman who has borne children. The body shows a still greater development. The folds of the arbor vitæ occupy only about two-thirds of the cervical canal. The external os of the cervix is dilated. (After Küstner.)

As the Müllerian ducts develop in the female there is a corresponding retrogression of the Wolffian ducts, remnants of which may later play a part in the formation of certain pelvic tumors.

Retrogression of the Wolffian body and ducts begins at the seventh or eighth week and is completed about the fifteenth to the sixteenth week of fetal life. Rests of these structures persist in the broad ligament under the name of the

"parovarium," which appears in the form of a comb, with the back running parallel with the tube, and the teeth extending in a somewhat radiating direction toward the ovary. The parovarium is divided into two parts, the outer (or, more exactly, the upper) part, near the tubal extremity, being termed the epoöphoron, and the inner (or lower) part, near the round ligament, the paroophoron. The thread-like strands of the parovarium are, in reality, minute canals lined with a low cuboidal epithelium and surrounded with a firm connective tissue (Schuler). In the paroöphoron portion are sometimes found rudimentary glomeruli. The small pedunculated hydatid cysts of Morgagni, often seen dangling from the edge of the broad ligament near the fimbriæ, are regarded as remnants of this Wolffian body.

The back of the comb-like figure, by which we have described the parovarium, represents the remains of the Wolffian duct. This duct may persist in a part or the whole of its course. Thus, there is sometimes a communicating tubule between the epoöphoron and the edge of the broad ligament in the fimbriæ. That part below the parovarium is sometimes also found to persist, and to it has been given the name "Gärtner's duct." As a rule, only short segments of this duct persist, but in a few instances it has been traced from the parovarium to the uterus, through the uterine musculature to the vaginal portion, and through the vaginal wall to an opening at the hymen. The course in the vagina is along the lateral or dorsal part of the wall.

The persisting rests of Gärtner's duct may be the seat of retention cysts or of epithelial new growths.

**Ovaries.**—To the median side of Müller's ducts and the Wolffian body appear at about the sixth week the rudiments of the genital glands, which in the male develop into testicles and in the female into ovaries. These structures are at first alike in both sexes, and consist of a connective-tissue ridge covered with cylinder epithelium. Differentiation into the male or female organ takes place in the next three months. The development of the ovary is characterized by a rich proliferation of cells from the epithelial covering (germinal epithelium), together with an ingrowth of connective-tissue cells and blood-vessels from the neighboring Wolffian body. The epithelial cells which permeate the structure become cut off and confined in balls or compartments (Eifächer of Nagel, Eiballen of Waldeyer), and form the basis for the primordial follicles.

The follicles first formed retreat toward the center of the organ, while new follicles are formed from the surrounding germinal epithelium which has a tendency to dip inward into the stroma (Fig. 9).

A remnant of this process can be seen in the newborn in the form of ingrowths of germinal epithelium into the stroma. This tendency of the epithelium surrounding the ovary to inversion often persists, and the cutting off in the stroma of such cell-inclusions undoubtedly is the basis of many ovarian new-growth tumors.

The ova, or germ-cells, are distinguished from the other cells by their greater

size. They are found included in the cell masses above described and scattered through the investing layer of germinal epithelium. After birth there is no further generation of new follicles. During the first year many of the primordial follicles already created disappear.

**Descent of the Ovaries.**—At about the third month of embryonal life the descent of the ovaries takes place. The gubernaculum of Hunter, which at first represents an abdominal fold, later becoming endowed with connective tissue and muscle-fibers, connects the Wolffian body with the inguinal canal at

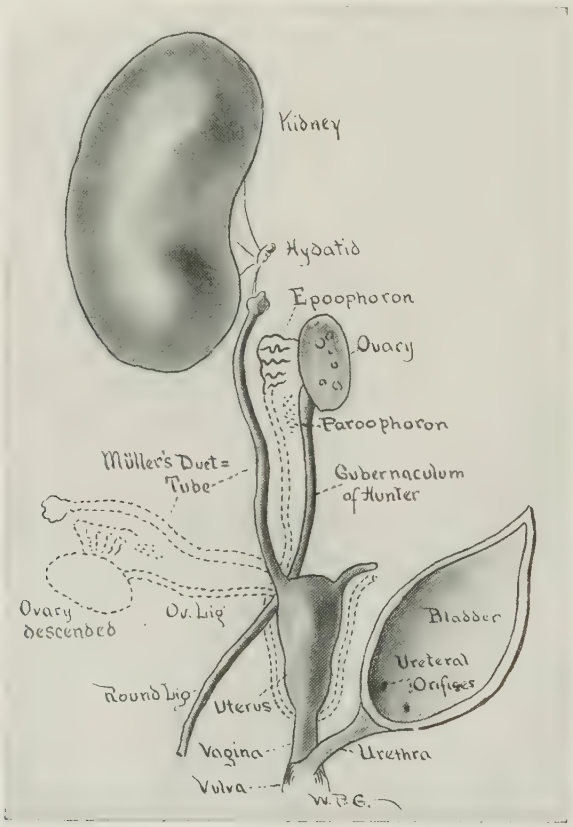


Fig. 187.—Diagram Showing Descent of Ovaries and Fusion of Müller's Ducts into Uterus and Vagina.

The way in which the gubernaculum of Hunter becomes the round and ovarian ligaments is shown.

an early period. At the time when the Wolffian body is in the process of retrogression this ligament fails to keep pace with the growth of the rest of the body, and exerts such traction on the genital gland that it is drawn downward into the pelvis. The gubernaculum of each side fuses in its upper third with the Müller's ducts at their point of union (fundus of the uterus), so that finally it is divided into two unequal portions, one that extends from the fundus to the inguinal canal, the round ligament, and one that runs from the fundus to the ovary, the suspensory ligament of the ovary.

Before full sexual development the ovaries remain relatively high, their complete descent into the depth of the pelvis being consummated after maturity, due possibly to the gradual increase in weight of the organ. (Adapted from Otto Küstner, in Küstner's Lehrbuch.)

The Wolffian and Müller's ducts primarily open below into the lower part of the allantois, which at this time represents an anterior extrusion of the end-gut from the body cavity. Later the walls of the abdomen join in the mid-line up to the umbilicus, and the portion of the allantois between the umbilicus and the openings of the Wolffian and Müller's ducts becomes the bladder and urethra. Below this level the descending part of the canal is termed the "urogenital sinus," while the ascending part is the rectum. The part into which these two canals empty in common is called the "cloaca."

## CONGENITAL DEFECTS OF THE UTERUS

Defects of the uterus occur chiefly as a result either of complete or partial failure of union of the two Müllerian ducts. An entire absence of uterine tissue does not occur, for even in the cases of congenital absence of the vagina there is

FIG. 188.—UTERUS DUPLEX BICORNIS CUM VAGINA DUPLICI. DOUBLE BICORNUATE UTERUS WITH DOUBLE VAGINA.
Normal in the opossum.

always a rudimentary development of the uterus, which sometimes exists only as a small retroperitoneal solid strand of tissue scarcely appreciable by rectal examination.

Failure of union of the Müllerian ducts may result in the following abnormal formations:

(1) Uterus didelphys, or uterus duplex separatus. This signifies a complete separation of the two halves of the uterus with double vagina. This form

is rarely seen in living human individuals, being usually associated with other malformations of the pelvis that are incompatible with life.

FIG. 189.—UTERUS DUPLEX BICORNIS. DOUBLE UTERUS.
Normal in the squirrel, hare, and beaver.

(2) Uterus duplex bicornis cum vagina duplici. In this case there is a separation of the two bodies, but the two cervices are fused. The vagina is double (Fig. 188).

FIG. 190.—UTERUS BICORNIS UNICOLLIS. BICORNUATE UTERUS.
Normal in the hyena, dog, goat, and sheep.

(3) Uterus duplex bicornis. Here the formation is like the preceding except that there is a single vagina.

(4) Uterus bicornis unicollis. In this type the body of the uterus is double,

but the cervix is fused into one. The two bodies may, however, not be widely separated, but lie closely together so that the fundus has a saddle shape.

(5) Uterus septus duplex. The external form of the uterus is entirely normal, but the entire canal is divided by a septum reaching from the fundus to the external os.

(6) Uterus subseptus uniforis. The external contour is normal, but there exists a partial septum extending from the fundus.

FIG. 191.—UTERUS SUBSEPTUS UNIFORIS. PARTIAL SEPTUM OF THE UTERINE CAVITY. Normal in the horse and the ass.

FIG. 192.—UTERUS BIFORIS. The uterine cavity is single, the cervical canal is double. Normal in the ant-eater.

FIG. 193.—UTERUS UNICORNIS. The adnexa of one side are wanting. Normal in birds.

(7) Uterus biforis. The canal of the body is normal, but a septum divides the cervix completely so that there is a double orifice (Fig. 192).

(8) Uterus unicornis. In this form there is complete absence of one-half of the uterus (Fig. 193).

The foregoing are the essential malformations, but they may assume various forms as a result of unequal development in the two sides. If both halves of a double uterus develop equally, both may functionate perfectly—*i. e.*, menstruate and conceive. Usually in double uterus one-half is better developed than the other, and if repeated pregnancies take place they occur in the same half. One-

half may be diseased with cancer or bacterial infection, while the other remains entirely unaffected. The opening of one-half of a double uterus may become closed, with resulting hematometra. When one horn of a double uterus is incompletely developed there may be a congenital atresia of its canal, and this may also eventuate in a hematometra. The symptoms of these two conditions are the same as those described under the subject of Gynatresia. Pregnancy may occur in a rudimentary horn. If there is a communication between the rudimentary horn and the main uterine canal an abortion may take place through the opening. Sometimes, however, a rudimentary horn which has no communication with the uterine canal may become impregnated by a wandering fertilized ovum from the *opposite* side. The clinical picture is then one of tubal pregnancy.

Double formation of the uterus, as a rule, has no special clinical significance unless there is atresia and hematometra. The diagnosis is usually difficult to make. If sepsis is not present, and one-half of the uterus is normal, the atretic half may be amputated.

Where pregnancy takes place in a rudimentary horn the treatment is the same as that of extra-uterine pregnancy, with amputation of the rudimentary horn if the other uterine body and adnexa are normal.

## DEVELOPMENTAL DEFECTS OF THE VAGINA

Most cases of defective vagina that produce symptoms are the result of inflammatory processes acquired after birth, as described in detail under the heading of Gynatresia (*q. v.*).

The developmental defects have chiefly to do with entire absence of the vagina or to septum formation, or to the union of two abnormally narrow Müllerian ducts.

In most cases of congenitally absent or defective vagina, except where there is septum formation, the uterus is functionless, so that no symptoms of retained secretions ensue at puberty, as in the case of acquired gynatresia. It often happens, however, that individuals, even with complete absence of the vagina and with rudimentary internal genital organs, may be otherwise fully developed both as to external genitals and the secondary bodily sexual characteristics. These women may have normal sexual instincts, and are often so attractive as to be sought in marriage. In such cases it sometimes becomes necessary to create an artificial vaginal pouch for the purpose of cohabitation.

In performing this operation it is first necessary to separate the bladder from the rectum, which are united along the area normally occupied by the vagina. A space is made by blunt dissection corresponding to the size of the normal vagina. The next step is to line this newly made pouch with an epithelial surface, as otherwise the raw surfaces cannot be kept from readhering. This may

be accomplished by turning in flaps from the labia minora and from the skin of the buttocks. A better, though more dangerous operation, is to bring down through an opening into the peritoneal cavity a resected loop of the intestine, to which is attached its corresponding section of mesentery. The pouch can thus be lined with a true mucous membrane, which is kept alive by its mesenteric circulation. An abdominal operation is necessary for the resection of the bowel and the union of the bowel-ends. The details of both methods of operation are described in Part III.

A third method is also described by which an artificial vagina is formed from a section of the rectum.

## DEVELOPMENTAL DEFECTS OF OVARIES AND TUBES

Absence of both ovaries occurs only in non-viable fetuses in which there is complete absence of genital elements. The failure of one ovary is seen in uterus unicornis or where one horn is extremely rudimentary.

On the other hand, an accessory ovary is sometimes, though rarely, seen. Whether the third ovary represents an independent separate growth from the start, or whether it was accidentally cut off from the normal ovary during early embryonal life, is a matter of doubt.

Absence of the tubes, like absence of the ovaries, occurs only on one side in the case of uterus unicornis.

Imperfect or hypoplastic development is discussed under the subject of Infantilism.

## DEFECTS OF THE URETHRA AND BLADDER

**Hypospadias** in the female differs essentially from that seen in the male. In the latter it relates to an opening of the urethra on the under side of the penis, at any point from the glans to the colliculus seminalis. This part is wanting in the female, in whom the urethra corresponds to that portion of the male canal which extends from the colliculus to the bladder.

Female hypospadias may represent various grades of deficiency, from moderate defects of development to complete absence of the urethral canal.

When the urethra is entirely wanting there is a funnel-shaped opening into the bladder, so that there appears to be a communication between the bladder and vagina. It should be remembered, however, that in embryonal life the urinary system at no time communicates with the Müllerian ducts, so that in complete hypospadias the urethral opening is really into the vestibule. When the defect of the urethra is complete, there is also an absence of the sphincter vesicæ with full incontinence of urine. When the urethra is incompletely developed the incontinence may be only partial.

The *treatment* of hypospadias is operative, and is directed to the control of

the urine. If the hypospadias is complete the success of the operation is always in doubt. If, however, the defect is partial and the vesical sphincter muscle is present, a skilfully performed plastic operation should cure the patient. The operative technic must be determined somewhat by the exigencies of the case, but may be carried out on the general principles recommended for Incontinence (see page 656).

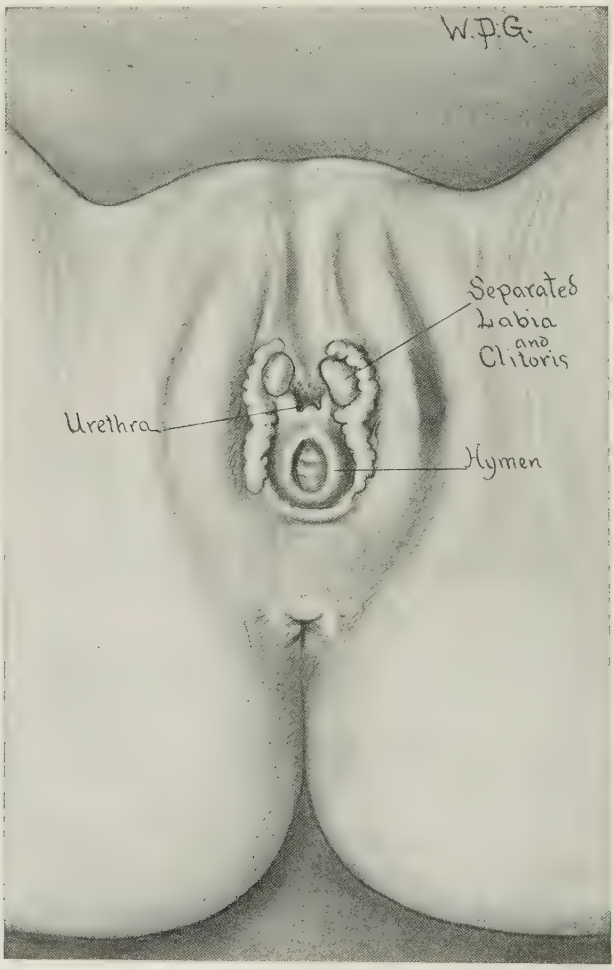


Fig. 194.—Epispadias.

**Exstrophy** and **epispadias** are comparatively rare conditions in the female. Both these malformations are different grades of the same embryonic defect.

In the early stages of development the cloacal membrane reaches to the primitive belly-stalk or forerunner of the umbilical cord. As the embryo grows the upper portion of this membrane disappears as the sides of the abdominal wall and pelvis join, while the lower part corresponds to the opening of the urogenital sinus and the rectum.

Under abnormal conditions the cloacal membrane may partially or entirely persist, due to the incomplete merging in the middle line of the sides of the muscular abdominal wall or of the pelvis. The thin epithelial cloacal membrane

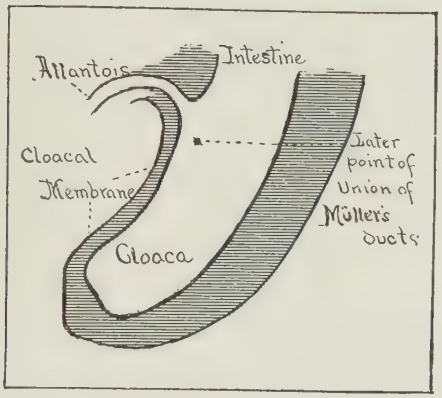


FIG. 195.—Common cloaca into which the gut and the allantois empty. The cloacal membrane reaches to the region of the later bladder and urethra. Knowledge of this membrane is important in understanding exstrophy of the bladder (Pankow).

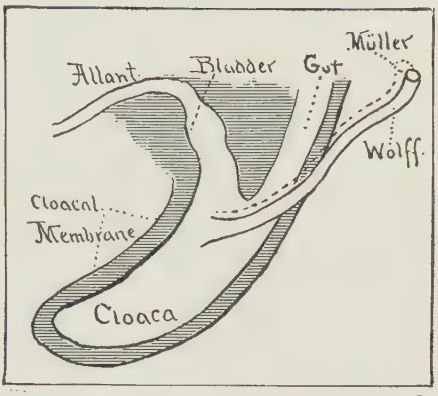


FIG. 196.—The cloaca separates into a ventral and dorsal part. The Wolffian ducts open into the ventral part. Müller's ducts at this stage are not established. The dotted line shows the position of their later development. The beginning of the bladder can be seen as a dilatation in the duct of the allantois (Pankow).

thus exposed soon breaks and allows the urinary contents of the bladder to escape through the opening of the belly wall. If the opening is extensive the

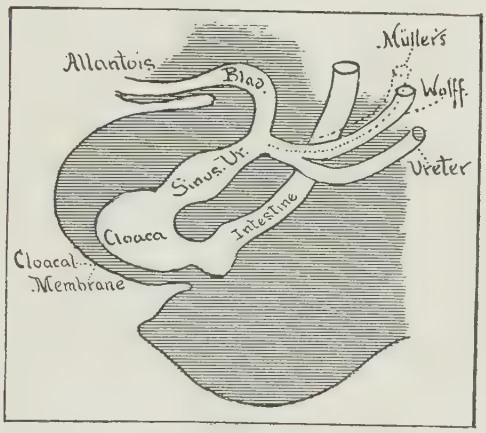


FIG. 197.—The sinus urogenitalis is formed. The ureter is seen sprouting from the Wolffian duct. The Müller's ducts have at this stage not yet reached the sinus urogenitalis, their future position being shown by the dotted lines (Pankow).

condition is called *exstrophy of the bladder*. The extrusion of the bladder is due to abdominal pressure which forces the posterior bladder wall out through the abdominal opening.

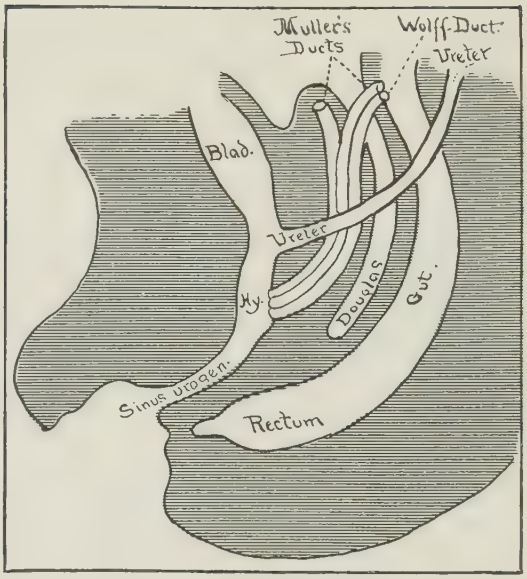


Fig. 198.—The urogenital sinus has broken through the cloacal membrane. The intestine is still closed. The Müllerian ducts have reached the urogenital sinus to the median side of the Wolffian ducts, but have not yet acquired an open lumen. The site of the future hymen is indicated. The ureter has separated from the Wolffian duct. The part between the ureter and Müller's ducts becomes the lower part of the bladder and the urethra. Douglas' pouch is indicated between the gut and the urogenital sinus. The shaded portion protruding to the left of the drawing represents the genital tubercle, the future clitoris (Pankow).

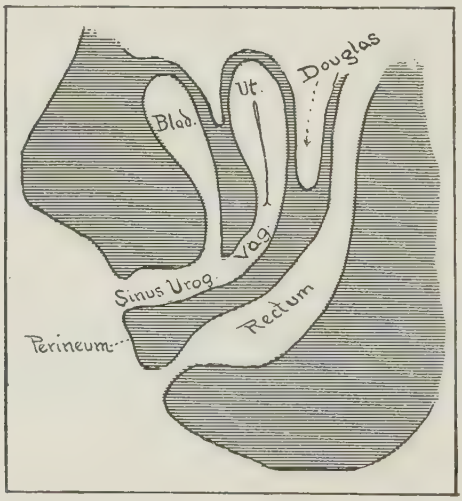


Fig. 199.—The urethra and vagina open into the common urogenital sinus, which gradually gets shorter and shorter, eventually becoming the vestibule. The perineum is developed. The rectum has established an opening through the anal dimple. The lumen of vagina and uterus has been formed (Pankow).

If the defect takes place so that only the upper part of the bladder is exposed the condition is called a *superior vesical fissure;* if the defect is in the

lower part of the bladder it is called *inferior vesical fissure.* If the separation is confined to the urethra and the vulva the condition is termed *epispadias.*

Inferior vesical fissure and epispadias may be combined.

In exstrophy and fissure of the bladder the urine usually passes completely through the abdominal opening. In epispadias incontinence may be complete or partial, or even absent in mild grades of the deformity.

*Treatment* is directed toward control of incontinence, and can be accomplished only by plastic surgery. Operations for exstrophy are difficult, and must usually be repeated several times before success can be attained. For moderate degrees of epispadias operations may be successful, but patients should always be told that it may require several or even many operations before a cure can be effected.

## ATRESIA OF THE ANUS

This term is applied to a condition in which the normal communication between the rectum and the outside world was not established during the process of development. In viable children two types of atresia are to be

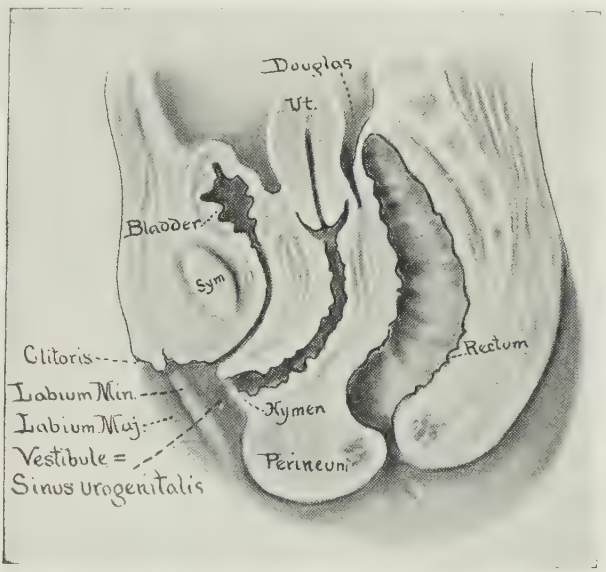


Fig. 200.—Section of Normal Infant's Pelvis.

distinguished: (1) where the lowest portion of the rectum is deficient and the bowel ends in a blind pouch, and (2) where the embryonal communication between the rectum and urogenital sinus persists. In the latter case, in the full-term child, the rectum opens into the vestibule.

True atresia of the rectum is properly applied only to the first type. This condition is discovered soon after birth by the absence of defecation, and requires immediate operative interference. Occasionally the atresia is due to

a simple gluing together of the superficial epithelium, in which case an opening is easily made by blunt puncture. If there is more than a thin membrane

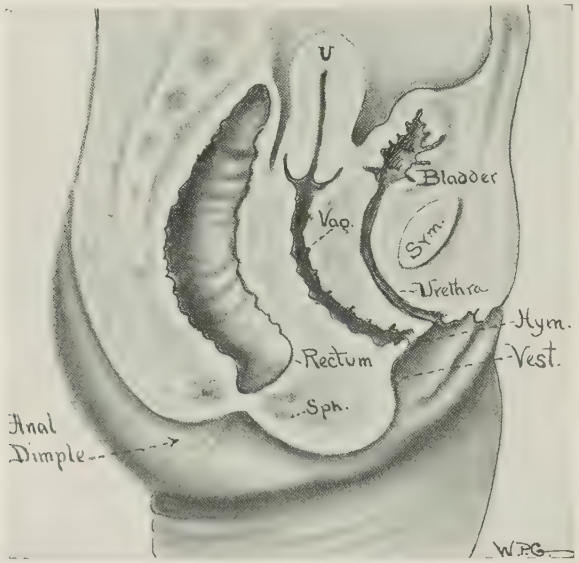


Fig. 201.—Imperforate Anus.

between the rectal pouch and the external anal dimple the operation is a serious one and accompanied by a high eventual mortality. The operation consists

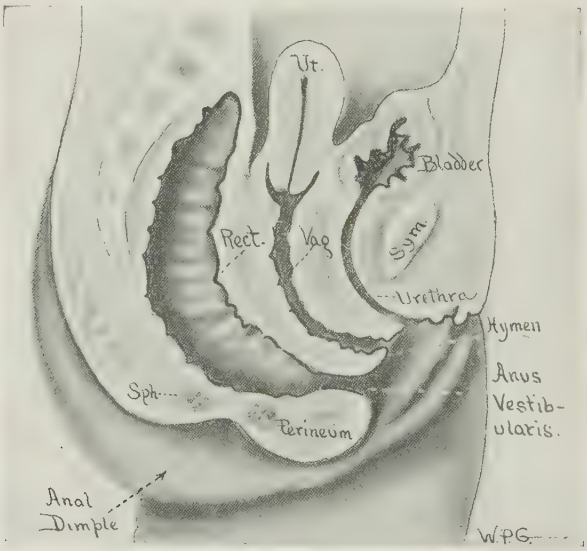


Fig. 202.—Vestibular Anus.

in making an anteroposterior incision through the anal dimple, dissection of the intervening tissue, and bringing the rectum down to the incision, to which it is

sutured. In all cases the sphincter muscle is present, so that, if the operation is skilfully performed, complete control of the bowels is secured. Many successful cases have been reported.

Anus vestibularis is the term applied to the second type of anal atresia. In this condition there is no opening through the anal dimple, but the former embryonal opening into the urogenital sinus persists (Fig. 202). As the vestibule in such cases is often deeply placed, the rectal communication appears to be in the vagina, and for this reason the condition is sometimes spoken of as a vaginal anus. This is incorrect, as a connection between the rectum and Müller's duct is embryologically impossible. The defect should always be termed "vestibular anus" (Pankow).

If the opening into the vestibule is very small, there may be obstruction to defecation and the newborn child may require surgical operation. Usually, however, the opening is large enough to permit the passage of feces, and patients with this defect often grow to adult life without knowledge of their condition. Some even conceive and bear children. Operation is, however, sometimes indicated if there is incontinence and uncleanliness, especially in women who contemplate marriage. The operation is not difficult, and usually results in perfect success. The rectal pouch is brought down to an opening through the anal dimple and sutured there, and a new anus established. The old vestibular anus is denuded and closed by suture.

## HERMAPHRODITISM

The sex of an individual is determined only by the nature of the genital glands (*i. e.*, as to whether they are ovaries or testes), and not by the appearance of the external genitals, nor by the development of the secondary sexual characters of the body.

True hermaphroditism implies the presence in the same individual of both ovarian and testicular tissue, fully developed and functionating. There are numerous instances of true hermaphroditism in some of the lower species of animal life, but in man it has never been demonstrated and probably does not exist, though several cases have been reported in which there has been found in the genital glands both ovarian and testicular tissue, the so-called ovitestes. In all of these cases only the elements of *one* sex were fully developed and capable of function. Such individuals could, therefore, not be termed true hermaphrodites.

The sexual intermediates that appear in the human species are always essentially male or female, though they may have the outward characteristics of the opposite sex. They are, therefore, properly designated as "pseudohermaphrodites."

Pseudohermaphrodites are divided into two classes—feminine and masculine. In individuals of the former class the structure of the genital glands is

ovarian, but external genitalia and the secondary sexual characteristics are of the male type. This class is comparatively rare.

Most pseudohermaphrodites possess the male genital gland, but are outwardly more of the feminine type. In these individuals the penis is rudimentary and is not perforated by the urethral canal. The meatus urinarius lies at the base of the rudimentary penis and often cannot be seen, especially in children, as it opens into a blind depression which closely resembles a vagina. The testes are either undescended or lie high up in separated scrotal sacs, which may have the exact appearance of labia majora. Individuals of this kind are usually regarded in childhood as girls, are given feminine names, and grow up as females. Sometimes male characteristics may develop as the child comes to maturity and call attention to the real sex. It is sometimes impossible to make a diagnosis of the correct sex except by microscopic examination of the sexual gland, a procedure which under ordinary circumstances is not feasible.

There may be great variations in the type of pseudohermaphroditism just described, depending on the development of the genital organs. The elements representing Müller's ducts are, as a rule, rudimentary, but, on the other hand, they may develop into nearly full-sized uterus, tubes, and vagina. At least one case has been reported of an individual who lived and cohabited both as a man and as a woman.

The testes of the pseudohermaphrodite possess a special predisposition to malignant degeneration.

## Malpositions of the Uterus

When a woman is standing the uterus lies normally in approximately a horizontal position. The anterior wall is in contact with the bladder, while on the posterior wall and in the recto-uterine pouch rest the intestines. This position of the uterus is not a fixed one, for, owing to the requirements of child-birth, the organ is necessarily mobile. Thus, by manipulation it can be rotated backward through an angle of 180 degrees, while laterally it can be turned through an angle of 45 degrees to each side. Pressing as it does on the wall of the bladder, its position is continually changing in an anteroposterior plane, accommodating itself automatically to the varying changes in the size of the bladder. Nor is its level in the pelvis a fixed one, for under the influence of forced abdominal pressure, such as results from straining, the elastic supports of the uterus allow a certain amount of descent in the direction of the pubic outlet.

Fig. 203.—Normal Position of Uterus.

The uterus, notwithstanding its remarkable mobility, nevertheless under normal conditions returns to its proper position after temporary displacement, such as may result from forcible manipulation, pregnancy, severe strains, rapidly growing tumors, or any influence that does not cause a fundamental change in the elasticity of its supports or its inherent muscular structure.

The axis of the uterus is not normally straight, for there exists between the body and cervix a moderate permanent angulation or anteflexion which has a considerable variation within normal limits. After the menopause the normal angulation disappears and the axis of the uterus becomes straight.

The nomenclature of uterine displacements has not been standardized. The following terms and definitions, though not in all particulars universally employed, have received the sanction of good usage:

*Retroversion* of the uterus means a turning backward of the entire organ on an axis situated approximately at the internal os. In an uncomplicated retroversion the cervix and body retain their normal relationship to each other, so that as the body turns backward the cervix points forward. For the sake of convenience, retroversion is divided into three degrees: The *first* degree in-

cludes deviations from the normal position to a point where the long axis of the uterus coincides with the long axis of the vagina. At this point the uterus is

FIG. 204.—RETROVERSION. FIRST DEGREE.

FIG. 205.—RETROVERSION. SECOND DEGREE.

said to be in the *second* degree of retroversion, and the cervix points in the direction of the vaginal orifice. Deviations beyond the second degree are said

FIG. 206.—RETROVERSION. THIRD DEGREE, WITH RETROFLEXION.

to be in the *third* degree, and the cervix tends to point correspondingly further forward.

*Anteversion* means a turning forward of the uterus. As a matter of fact, the uterus in its normal position is turned forward as far as it can go, resting as it does on the bladder. The term "anteversion," therefore, describes the normal position of the uterus and does not denote a displacement, as it was formerly supposed. The term is rarely used at present.

*Lateral version* means a turning of the uterus to the right or left.

*Retroflexion* of the uterus means a bending backward of the body on the cervix, causing an angulation of the posterior wall. The flexion takes place at the internal os. It is usually a more advanced manifestation of retroversion, and does not occur until the uterus has reached the third degree of retroversion. When retroversion and retroflexion are combined it is customary to say that the uterus is in a position of *retroversion-flexion.*

Fig. 207.—Lateral Version.

Fig. 208.—Lateral Flexion.

*Lateral flexion* means a bending of the uterine body on the cervix to the right or left. If there has been also a version involving the cervix, one speaks of *right* or *left version-flexion.*

*Anteflexion* relates to forward angulation between the body and cervix. The uterus is normally anteflexed to a certain degree. The term "anteflexion" is used to denote an abnormal amount of angulation. The condition is described more exactly by *hyperanteflexion,* a word that is not in common use.

*Retrocession* is a specialized term that relates to a condition in which the uterus has receded to a position nearer the sacrum than normal, but in which the fundus continues to point forward. In the majority of anteflexion cases the whole uterus is abnormally far back, and is said, therefore, to be retrocessed. Conversely, retrocession, when properly used, implies an anteflexion of the body.

*Anteposition* denotes that the uterus, as a whole, is in a position abnormally near the pubes or anterior abdominal wall. This position is created by the

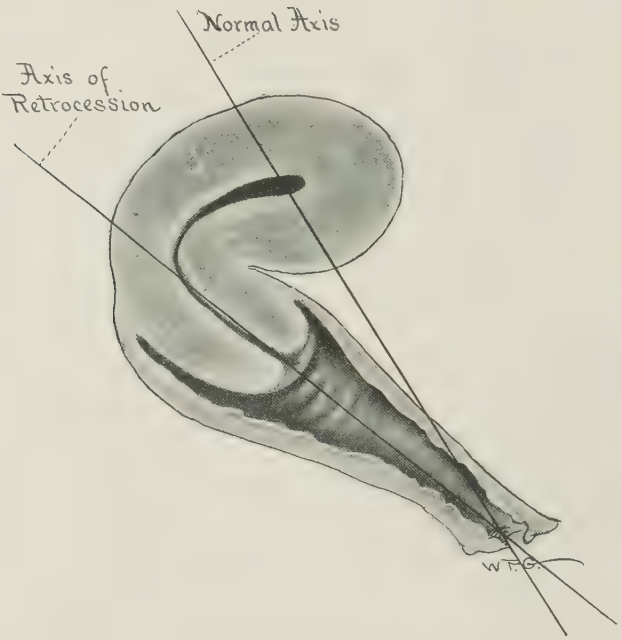


Fig. 209.—Anteflexion with Retrocession.
The whole uterus sags back toward the sacrum.

pressure from behind of a tumor situated in the posterior culdesac, or by abnormal attachment of the fundus to the anterior abdominal wall.

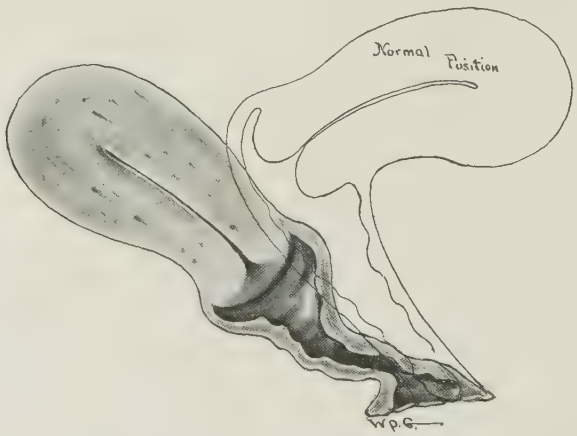


Fig. 210.—Retroversion and Prolapse (Descensus) of the Uterus.

*Retroposition* and *retrolocation* are terms vaguely used, and may include retroversion, retroflexion, and retrocession.

*Prolapse* of the uterus denotes a permanent descent of the uterus from its physiologic level in the direction of the vaginal introitus. The word *descensus* describes the condition more accurately, but is not as commonly used. The term "prolapse" relates to all degrees of descent of the uterus until the cervix reaches the vaginal introitus.

*Procidentia* denotes extreme prolapse, and includes all conditions in which the cervix extrudes from the vaginal introitus (Fig. 211).

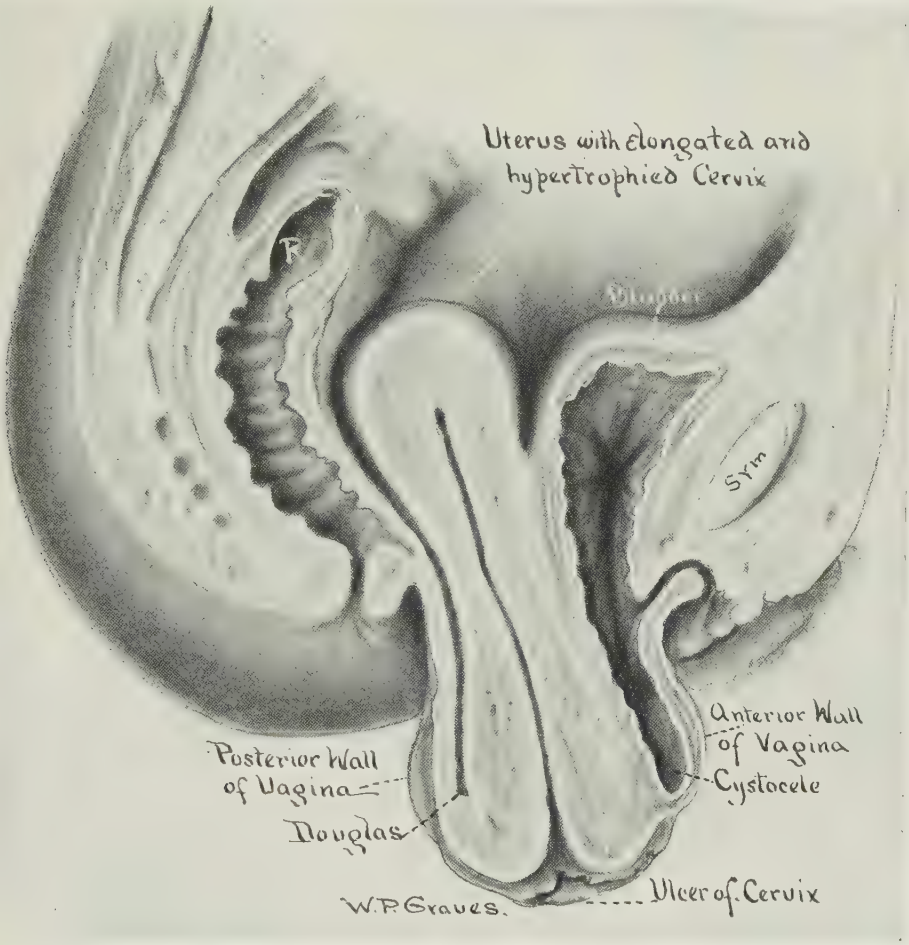


Fig. 211.—Procidentia Showing Elongation and Hypertrophy of the Cervix.

*Complete procidentia* is used to designate the extrusion of the entire organ from the vaginal orifice (Fig. 212).

The word "prolapse" is sometimes applied to the vaginal wall. When used in this sense, prolapse of the anterior vaginal wall corresponds to a cystocele, while prolapse of the posterior wall is identical with a rectocele.

*Torsion* of the uterus means a twisting of the body on the cervix in the vertical axis.

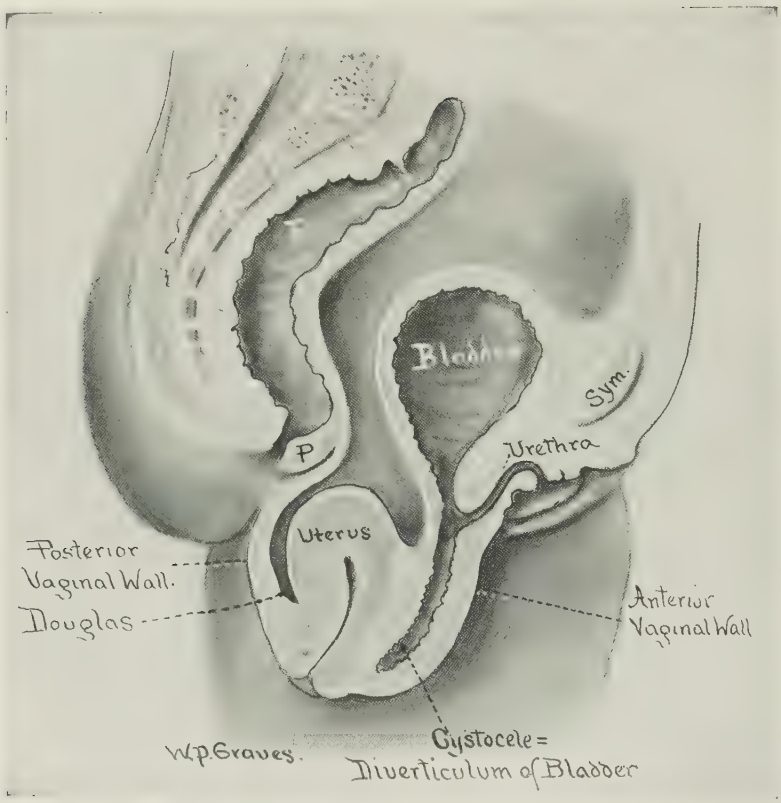


FIG. 212.—COMPLETE PROCIDENTIA.
The entire uterus is outside of the body.

*Elongation* of the uterus means a lengthening of the organ by pressure, tension, or hypertrophy. The elongation may occur in the body, in the cervix, or in both.

*Inversion* of the uterus means a turning inside out of the entire organ.

## RETROVERSION AND RETROFLEXION

**Etiology.**—We have seen that the uterus during the erect posture lies in a horizontal plane, with the anterior surface resting on the fundus of the bladder, while abdominal pressure is exerted on the posterior uterine surface through the medium of the intestines.

In general, the uterus is maintained in its normal forward position by three factors: first, by the proper tone of its anatomic supports; second, by the elasticity of its musculature; third, by the abdominal pressure which serves to keep the anterior uterine wall in contact with the bladder. Backward rotation of the uterus occurs when these factors cease to exert their proper influence, and this may happen in the following ways:

(1) The supporting tissues of the uterus or its own musculature may be-

come permanently weakened, so that the fundus sags back from the bladder. This allows the intestines to enter the vesico-uterine space, so that abdominal pressure is now exerted on the anterior surface of the uterus, and serves gradually to force it backward into the posterior culdesac. The weakened supports of the uterus cannot cope with the force of the abdominal pressure and the retroversion becomes permanent.

(2) The fundus of the uterus may be forcibly and permanently dragged back by the formation and shrinking of adhesions that form between its posterior surface and the rectum and pelvic wall, or by tumors attached to the posterior wall.

(3) The uterus may be pushed back by various tumor growths.

A special fourth type comprises cases where the uterus has developed in the posterior position. This type, however, would properly be included in the first-mentioned class, as the condition is undoubtedly due to a congenital deficiency in the uterine supports or musculature.

Each one of these types presents special clinical features, and we shall, therefore, consider them separately.

### RETROVERSION DUE TO RELAXATION

Lax pelvic supports may be acquired by pregnancy and childbirth, or they may be due to a physiologic insufficiency of tissue in the suspensory apparatus, or they may result from a combination of both causes.

By far the greatest number of retroversions follow child-bearing. The tissues of the uterus and of all its supporting structures are enormously hypertrophied and stretched during pregnancy. These tissues by normal involution return nearly but not quite to their original form and tonicity. Permanent laxness of these tissues results from an incomplete involution of the parts after the puerperium. This may be brought about by various factors. The important cause is a congenital insufficiency inherent in the tissues themselves. Individuals differ greatly in respect to the tone, elasticity, and recuperative power of their supporting tissues, as is shown by the fact that some women who have borne many children often show astonishingly little damage to their pelvic supports, while in others only one childbirth may result in the most extreme displacements. In the latter case the patients often present other evidence of deficient tissue-supporting strength, such as enteroptosis, diastasis of the abdominal recti, etc. Rapid and frequent pregnancies may result in permanent laxity of pelvic support even in those naturally endowed with good tissues. The early getting up from child-bed is an occasional factor in the causation of retroversion, but its frequency is probably exaggerated.

The social condition of the patient undoubtedly plays an important part. It has been our experience to find displacements following child-bearing far more frequent among the working class than among the well-to-do. This is only partly explained by the better physical inheritance that the well-to-do in

general possess. Other causes are more important. Poor women work hard and continuously during the period of pregnancy, most of them without efficient abdominal support. The strain of constant severe abdominal pressure necessitated by physical work, and unrelieved by proper rest or support, must produce a greater stretching of the pelvic tissues, and therefore results in a more incomplete involution than is the case in the more fortunate woman who can regulate her life to her condition.

Heavy work soon after the puerperium, entailing as it does forcible abdominal pressure, is also a factor. It is possible that lack of nourishment and intercurrent disease may have a deleterious effect on the supporting tissues during pregnancy and the puerperium, though it is probable that they do not in the non-pregnant state. Long lactation periods, such as poor women are prone to subject themselves to, may weaken the pelvic structures by means of the local atrophy which overlactation produces in the genital system.

Besides the damage that may be done to the uterine supports, we must consider also the influence which pregnancy exerts on the musculature of the uterus. It has been shown (Theilhaber) that when the uterus develops into maturity the proportion of muscular tissue to connective tissue in the uterine wall becomes as 3 to 2 instead of 2 to 3. It has also been shown that each pregnancy diminishes the relative amount of muscular fiber. At the menopause the uterus becomes atrophied, chiefly at the expense of the musculature, so that the connective-tissue element again predominates.

Repeated pregnancies may by their influence on the musculature cause the uterus to lose its proper tone so that it becomes flaccid. This flaccidity is most apparent at the level of the internal os, so that the body may turn on the cervix as if on a hinge. Such a uterus tends to sag backward away from the bladder in certain positions of the individual, so that the intestines have an opportunity to fall into the uterovesical space, and, by exerting pressure on the anterior wall, gradually to cause a retroflexion.

After the menopause the uterus is always in the second degree of retroversion if the physiologic process of atrophy takes place normally. This is due to the change in the musculature of the uterine wall. The uterus loses its form of angulation and the body becomes smaller, lighter, and more flaccid. It sags away from the bladder and the intestines enter the uterovesical space. The body of the uterus, however, being small and light, and the uterine supports being somewhat shrunken, complete retroversion does not take place. The uterus remains straight, with its long axis pointing in the direction of the vagina and lying among the intestines, which act as a cushion both in front and behind. It is important to remember, therefore, that retroversion of the senile uterus is physiologic and not pathologic.

In nulliparous women lax uterine supports that allow an acquired retroversion are usually the manifestation of a congenital lack of tone in the supporting tissues. This tendency may be confined to the pelvis, or the pelvic condi-

tion may be part of a general lack of tone seen elsewhere. Women who have ptoses of the various abdominal organs are very apt to have an associated retroversion. On the other hand, some women show the tissue weakness only in relation to the pelvic organs. In the latter case the condition may be one of local infantilism.

The mechanism of retroversion in women with congenitally lax tissues is the same as that in women whose supports have been damaged by childbirth, namely, a sagging backward of the uterine body so as to allow the intestines to exert pressure on the anterior surface.

Congenital insufficiency may, of course, act in combination with pregnancy to produce displacements of the pelvic organs, as we have already seen.

The uterus may at puberty develop in the position of retroversion, and when this occurs we speak of the condition as congenital retroversion. In infancy and childhood the uterus is always retrocessed and it may be retroverted. Congenital retroversion is, therefore, a phase of infantilism. There are usually other manifestations of infantilism in association with retroversion, such as a short anterior wall of the vagina and short uterosacral ligaments.

One cause of congenital retroversion is an incomplete descent of the ovary. In these cases the infundibulopelvic ligament is short, and by dragging backward on the uterus prevents a normal anteversion.

Retrocession may be the result of lax pelvic supports. We have limited the term "retrocession" to the condition where there is a backward position of the uterus toward the hollow of the sacrum, but where the uterine body retains its anteflexed relation to the cervix. Retrocession may be the result of the injury of childbirth to the supporting tissues, but it is more commonly a manifestation of infantilism, and, as there is nearly always associated with it abnormal anteflexion, the subject will be discussed under that heading.

It should be noted that the relaxation of pelvic supports with consequent permanent retroversion is not the result of ordinary falls and jars. In a woman with normal pelvic organs nature has provided for accidents of this kind. Unless a woman has a very full bladder, the sudden increase of abdominal pressure serves only to force the uterus into its normal position. If the bladder is full it is conceivable that the uterus might be forced backward from the bladder by the entrance of the intestines in the uterovesical space. Unless the force is great enough to cause actual destruction of the tissues, the natural elasticity of the uterus and its supports cause it to return immediately to its normal position. It was formerly thought that various forms of acquired displacement, such as retroversion, prolapse, and procidentia, are frequently caused by falls and injuries, but it is now known that these conditions are due to the gradual stretching of supports either congenitally weak or damaged by child-bearing.

**Pathologic Conditions.**—The retroverted uterus following child-bearing is usually large, heavy, and congested as a result of obstruction of the circulation. The uterine vessels enter the uterus on the sides at a right angle. Backward

rotation of the organ, therefore, causes a torsion in these vessels so as partially to obstruct the veins. The circulation from the ovarian vessels is also interfered with by the downward drag of the ovaries and broad ligaments. The enlargement of the uterus is at first due to engorgement, but the chronic state of congestion may result in a permanent hypertrophy of the uterine wall.

The contour of the congested retroflexed uterus is often somewhat uneven, receiving as it does impressions from the surrounding surfaces in which it is embedded, and has a deep purple mottled color. The consistency is softer and less elastic than normal. On restoring a retroflexed uterus to its proper position during an abdominal operation it is often possible to observe a very marked change take place in a few minutes. The uterine body becomes smaller and firmer, somewhat erectile in consistency, while the surface becomes smooth and of a normal pink color. The endometrium of a retroverted uterus usually shows a permanent hypertrophy which is like that of the physiologic phases, but somewhat more marked. This is doubtless due to the circulatory disturbance.

The circulatory change caused by a retroflexed uterus is shown also by a dilatation and often a varicosity of the pampiniform plexus of veins in the broad ligament. This condition of the veins is an important factor in the symptomatology of retroversion-flexion. The ovaries, suspended as they are from the posterior wall of the uterus, share in the retrodisplacement and lie in the lateral culdesacs of the pelvis in a position of so-called prolapse. They are also apt to be affected by the obstructed circulation. The physiologic cystic degeneration of the follicles tends sometimes, though not always, to become exaggerated beyond the normal limits. This change is much more likely to occur if the ovary is immobilized by adhesions. The surfaces of ovaries that have been long prolapsed sometimes become sclerotic, owing to a thickening of the albuginea.

The tubes of a retroflexed uterus often appear swollen and congested, but permanent changes probably do not occur in them unless they become adherent.

The question as to whether a long-standing retroflexion of the uterus may result in traumatic adhesions is one about which there has been a considerable difference of opinion. The earlier writers accepted the possibility and frequency of such adhesions almost universally, but at the present time the belief of the best authorities is that under ordinary conditions they rarely occur except as a result of infection. There is no doubt, however, that pressure adhesions on the posterior surface of the uterus may result from improperly fitting pessaries.

The question of traumatic adhesions from retroversion is sometimes a matter of considerable importance, especially in the argument of medicolegal cases. In this connection it might be remarked that it is difficult to see why the posterior surface of the uterus, lying in contact with the rectum, should become adherent any more readily than does the anterior surface of the uterus in its normal contact with the bladder.

Retroversion of the uterus, as will be emphasized later, is usually the first stage of descensus or prolapse. In fact, it may be said that a retroverted uterus from relaxed supports is always in a greater or less degree of prolapse, a fact which, we shall see later, is of the very greatest importance in relation to the symptomatology and treatment.

**Symptoms of Retroversion Due to Relaxation.**—Some women with even marked degrees of retroversion exhibit no symptoms whatever. This fact has led some to infer that the backward displacement of the uterus is physiologic (Cabot). Such observations are erroneous, for there can be no doubt that the great majority of women with retroversion suffer in some way from the condition. The two most common symptoms directly caused by retroversion are backache and the sense of pelvic pressure.

In the analysis of a series of 500 cases of retroversion from all causes the writer found that sacral backache was a definite symptom in 76 per cent. The cause of backache as a result of backward rotation of the uterus has not been satisfactorily explained, and for that reason its existence as a definite symptom of retroversion has been denied (Cabot).

The confusion that has arisen in this subject is partly due to the supposition that retrodisplacements may cause backaches at any level of the spine. It should be remembered that backache from retroversion occurs only in the sacral or very low lumbar region and is always central. Of the fact that retroversion of the uterus does cause backache in this location there is no doubt whatever.

The nature of the pain is not entirely characteristic. It is often worse on exertion or standing. Sometimes it is worse at night. It is often difficult to differentiate it from sacro-iliac or muscular strain.

The sense of pelvic pressure may be combined with a sacral backache or it may exist as a symptom by itself. This symptom is the result partly of the increased weight of the uterus, but is chiefly due to its condition of prolapse. It may appear as a definite bearing-down feeling which is increased or brought on by standing, or it may manifest itself as an early state of tire on exertion.

The physical exhaustion resulting from retroversion and prolapse has a very important influence on the general health of the patient, and especially on the nervous system. It is the commonest occurrence to see active, athletic, good-tempered women after several childbirths become nervous, irritable, unreasonable, discontented, easily exhausted, and apparently completely changed, both nervously and physically, as a result of the constant pelvic discomfort and weakness from retroversion and prolapse. There may be numerous secondary symptoms that develop from the general nervous disturbance, such as headaches, muscle pains, indigestion, constipation, etc., which are to be regarded as indirectly caused by retroversion of the uterus.

Patients with retrodisplacement frequently complain of pain in one or both sides. When pelvic inflammation is not present these pains are commonly assigned to the ovaries. Some even speak of an ovarian neuralgia, others ascribe

the pain to the cystic degeneration of the ovaries. The pain is probably due usually to the varicose condition of the veins of the broad ligament.

Patients with retroversion in about 56 per cent. of cases suffer some disturbance of the menstrual function (author's figures). A secondary dysmenorrhea is often present, manifested by an exaggeration of the symptoms that occur during the intermenstrual period. Thus, backache, pelvic pressure, pain in the side are increased during catamenia, as are all the nervous and general and constitutional symptoms.

Patients with congenital retroflexion usually suffer from essential dysmenorrhea, the pain often being located in the back instead of in the abdomen. True dysmenorrhea is more common in backward displacements when there is also flexion. Abnormalities in the menstrual flow are not infrequent, though not constant. Owing to the obstruction of the circulation and the permanent hypertrophy of the endometrium that are common in the retroverted uterus, various degrees of menorrhagia are encountered.

Irregularity in the time of the intermenstrual periods is apt to exist, the irregularity consisting usually in a too frequent incidence of the menses.

Leukorrhea is often present as a result of a hypersecretion of the congested endometrium.

Constipation is present in about 51 per cent. of cases (author's figures). This may possibly be due to partial obstruction of the rectal lumen, but it is more probable that the pressure of the uterine body on the wall of the rectum interferes with the normal muscular movements of the gut, thus diminishing its expulsive force.

Retroversion is said to cause symptoms of irritable bladder by a backward pull on the bladder wall. This is probably not true. The bladder is an extraordinarily adaptable organ, and when one considers abnormal positions in which it can be placed without symptoms during various reconstructive operations it is difficult to believe that the slight traction exerted by a retroposed uterus could cause definite symptoms of irritability. Irritable bladder is frequently caused by childbirth, and may thus be associated later with a retroversion, without causal relation between the two conditions.

Retroversion is a not uncommon cause of abortion. This may be due to the permanent hypertrophy of the endometrium, which offers a poor soil for the growth of the ovum, or it may possibly be referred to the imperfect circulation of the maternal blood through the uterus. Impaction of the pregnant uterus in the pelvis may cause abortion as a result of interference with the growth of the uterine musculature.

Women with retroversion are apt to be sterile, especially those in whom the retroversion is due to congenitally weak supports.

In women with retroversion acquired from childbirth the sterility, if present, is probably the result of the displacement of the cervix which no longer dips into the receptaculum seminis. In women with naturally insufficient supporting

tissue the same cause may act, but there are also apt to be other manifestations of infantilism which may combine to prevent fertility. (See Sterility.)

The **diagnosis** of retroversion and retroversion-flexion is usually a simple matter, and skill can be acquired with comparatively short experience. If the touch is gentle, so as not to cause pain and resistance on the part of the patient, it is rarely necessary to use an anesthetic. The method of using a uterine sound or probe is obsolete, unsurgical, and dangerous. Examination is much more accurate with the patient on a table than on a bed. It is very important that the bladder should be emptied immediately before the examination, as a full bladder may cause a considerable degree of backward rotation. The position of the uterus can be diagnosed entirely by bimanual examination, inspection of the cervix giving no additional evidence of value.

Retroversion of the first degree is determined by the external hand on the abdomen, which feels the fundus pointing away from the bladder.

In retroversion of the second degree the fundus of the uterus cannot be felt either by the abdominal hand or by the internal vaginal finger. The cervix is found pointing in the direction of the long axis of the vagina. In retroversion of the third degree the posterior wall of the uterus can be felt by the vaginal finger dipping backward into the culdesac of Douglas. If there is retroflexion the angle between body and cervix is readily felt. In third degree retroversion and flexion the cervix points either in the direction of the axis of the vagina or forward toward the anterior vaginal wall.

One of the commonest errors in diagnosis is to mistake an anteflexion with retrocession for retroversion. The cervix of anteflexion points in the same direction as that of a retroversion, and as the posterior wall of the cervix in these cases is often abnormally long it may be mistaken for the posterior wall of the uterus. The error is still further facilitated by the fact that when anteflexion and retrocession are present the fundus, though pointing forward in its relation to the cervix, cannot always be felt by the external abdominal hand. The anterior angle between the fundus and cervix, however, can always be made out by the vaginal finger feeling along the anterior cervical wall. If this precaution be taken the mistake need never be made.

If the hymen is very tight it is sometimes necessary to make a bimanual rectal examination. This requires more skill than does a vaginal examination. With the finger in the rectum the cervix feels very much larger than it does per vaginam, and it is frequently diagnosed as a pelvic tumor by the inexpert. With the finger in the rectum the uterus can be perfectly well felt bimanually, but, on account of the indistinctness with which the cervix is felt, it is sometimes difficult to tell which is the fundus and which is the cervix. One is, therefore, sometimes in doubt after rectal examination whether the uterus is in the normal position of anteversion or in the third degree of retroversion-flexion.

The fundus of a large uterus sharply retroflexed is often mistaken for a myoma growing centrally on the posterior wall, and vice versâ.

**Treatment.**—When a retroverted uterus causes no symptoms there is no need of treating it.

When a retroverted uterus gives no symptoms, but there is an associated sterility or tendency to abortion, treatment is indicated.

When retroversion definitely causes symptoms, treatment is advisable.

The treatment of retroversion due to relaxation consists in restoring the uterus to its normal position, and this can be done by orthopedic or surgical measures. Orthopedic measures comprise the various forms of rings and pessaries applied in the vagina to support the uterus from below, while surgical treatment includes numerous operative procedures for suspending the uterus from above.

*Pessaries* are of considerable value in the treatment of retrodisplacements with prolapse, but for uncomplicated retroversion they have only a limited field of usefulness, excepting as a temporary palliative measure. Occasionally women wear pessaries for years without discomfort, but, as a rule, they become a source of annoyance in a comparatively short time. They require constant attention in order to keep them clean, and even when properly cared for cause a mild vaginal irritation. If they are neglected or if they fit improperly, they may cause severe ulceration and vaginitis. The long-continued wearing of a pessary acts as a nervous irritant, and patients with a tendency to pelvic neuroses are made worse by their use.

Pessaries keep the uterus forward by pressure on the posterior wall of the cervix near the internal os. If the tone of the musculature has been damaged, so that the uterus is retroflexed, the pessary exerts its force directly at the point of flexion, and consequently aggravates the condition. Pessaries should never be used, therefore, when retroflexion is present.

Pessaries are most valuable in treating retroversion during the early months of pregnancy and immediately after the puerperium. A lax retroverted uterus that becomes pregnant is in serious danger of aborting. Such a position produces pelvic pressure and is a frequent cause of so-called reflex vomiting. The application of a pessary which holds the uterus in its normal position until the fourth month, when it rides above the pelvis, will often avert the danger of abortion and relieve the symptoms of pressure and nausea.

If after the puerperium it is found that the uterus is subinvoluted and tends to sag backward, a permanent retroversion may often be prevented by the use of a pessary until the uterus attains a normal size and consistency.

For most cases of retroversion that give symptoms surgical treatment is the most satisfactory. At the present day this usually involves opening the abdomen and employing one of the many methods devised for maintaining the uterus in its forward position. The technical details of the best of these operations are described in the section on Surgery. We shall discuss here some of the principles underlying those operations. In the days when opening the abdominal cavity was a dangerous procedure the Alexander operation was

devised. This consists in exposing the inguinal canals by two incisions and drawing on the round ligaments until the uterus is brought to a forward position. The slack of the round ligaments is either removed or sewed in the inguinal wounds. By this operation the abdominal cavity need not be opened and the danger of peritonitis is avoided. It is also a safe procedure with reference to future childbirth. The operation at present is comparatively little used in this country, as it has numerous disadvantages. It is often difficult to find the ligaments in the inguinal canals; small undeveloped ligaments break off easily during the process of drawing them out of the abdomen; if undetected pelvic adhesions exist, the operation is entirely nullified; it is impossible adequately to inspect the pelvic organs, and, most important of all, the percentage of recurrence is very high as compared with that of other operations.

Abdominal operations consist of various surgical devices by which either the uterus is attached to the anterior abdominal wall or its ligaments are employed so as to provide a new and artificial support.

Operations for attaching the uterus bodily to the anterior abdominal wall are called *ventral suspension* and *ventral fixation.* These two terms are somewhat vaguely used, but at the time when the operations were popular ventral suspension implied that the uterus was sewed to the peritoneum only, while fixation meant that the supporting sutures passed through peritoneum, muscle, and fascia. The first of these operations often resulted in drawing the peritoneum out into long filiform bands, and has been entirely discarded. The second operation of fixation, when thoroughly done, resulted in too firm an adhesion of the uterus to the abdominal wall, causing symptoms of local discomfort and occasional dystocia. This operation has also been given up except in some cases of prolapse in women beyond the child-bearing period.

Another type of operation comprises the principle, introduced by Gilliam, of drawing a loop of each broad ligament through the abdominal wall at some point. The number of modifications of this operation is very great, as will be seen by referring to the section on Surgery, where the details of the most important are described. Operations performed by the Gilliam method are very efficient in maintaining the position of the uterus, the percentage of recurrences being almost negligible even after childbirth. There are some objections to the operation. It is not always possible to control exactly the position of the uterus on account of the variation in the site of the natural attachment of the round ligaments to the uterus. If the attachment is low, drawing the ligaments tightly through the abdominal wall faces the uterus too much toward the abdominal wall, and causes a retroflexion of the body at the same time. This position is too far from the normal and sometimes gives trouble. If the uterus is drawn up too tightly, as it is liable to be by this operation, the ovaries and tubes are brought to too high a level, and may become involved in postoperative adhesions near the abdominal wall. The operation is also liable to result in

creating a diaphragm across the pelvis consisting of uterus and broad ligaments. This has been known to result in serious dystocia.

Another type of operation has for its principle the reduplication of the supporting ligaments without making artificial suspensory attachments. The earliest of these operations consisted in a simple reduplication of the round ligaments. The principle of this operation is like that of Alexander's, except that the shortening of the ligaments is done intra-abdominally. This method of support is extremely inefficient, and is followed by a large percentage of recurrences. A more efficient operation of this type is the so-called "Webster-Baldy operation," by which the round ligaments are drawn backward through an artificial opening in the broad ligaments and attached to each other on the posterior wall of the uterus. This brings the uterus into a more nearly normal position than does any other operation yet devised, and is indicated in many cases of uncomplicated retroversion. If, however, there is much prolapse or the uterus is heavy, or there is liability of postoperative adhesions, the results of this operation are not uniformly good.

Another operation of the reduplicating type is that devised by Coffey, by which the broad ligaments are folded in together in front of the uterus. The results of this operation are not entirely satisfactory and it has a limited field of usefulness.

The operation, suggested many years ago by Olshausen, is one of the simplest and most efficacious of all the various procedures, and is applicable to all forms of retrodisplacement. By this operation a single ligature is passed around each round ligament, near the uterus and through the peritoneum, rectus muscle, and fascia. The ligatures are tied very tightly, so as to create a small ligamentous adhesion between the round ligament and the abdominal wall. By varying the distance of the ligature from the uterine body and the point of attachment on the abdominal wall the desired position of the uterus can be exactly determined. The results of this operation if properly done are almost constant, and the disadvantages mentioned in reference to the other operations are practically obviated. The operation is also applicable to conditions of prolapse excepting severe procidentia. The results as regards child-bearing are most satisfactory.

In all operations in which the uterus is suspended from the abdominal wall, except in Simpson's and Mayo's modification of the Gilliam method, the possibility of intestinal obstruction cannot be absolutely ruled out. If the operations are properly performed the possibility is exceedingly remote, except in the now obsolete ventral suspension, with its resultant filiform band.

Some prefer reposition of the uterus by the vaginal route.

A method for vaginal fixation is described in Part III.

### RETROVERSION DUE TO ADHESIONS

Adherent retroversion is a result of pelvic peritonitis, the most common causes of which are gonorrhea, puerperal infection, and tuberculosis. An additional cause is the pelvic extension from an acute appendicitis, especially when the attack occurs in young girls. Retracting adhesions may also be due to

improperly fitting pessaries. As has already been explained, the exudate of a pelvic peritonitis settles by gravity in the posterior culdesac, and the drying and organization of the exudate results in adhesions of the posterior surfaces of the uterus and adnexa. The shrinking of these adhesions draws the uterus backward into the position of retroversion or flexion.

A common cause of adherent retroversion is the dense adenomatous adhesions that are produced by perforating hemorrhagic (chocolate) cysts (*q. v.*).

Adherent retroversion differs from the retroversion of relaxation in that there is, as a rule, no descensus or prolapse. In fact, the uterus is held more or less rigidly at its normal level by the pelvic adhesions. This fact, as we shall see later, is a matter of clinical importance.

The pathologic anatomy of adherent retroversion is that of pelvic inflammation, and has already been described in the section devoted to that subject.

The **diagnosis** of adherent retroversion is not always an easy matter. When an obvious inflammation of the adnexa is present, it is known that the retroverted uterus must share in the general inflammatory process, and is, therefore, probably adherent. It may be that the inflammation of the adnexa has subsided to such an extent that they cannot be palpated. In this case it is difficult to differentiate an adherent retroversion from an impacted non-adherent retroversion.

Sometimes the uterus becomes attached to the rectum in such a way as to allow considerable mobility, even to the extent that the displacement may be partially reduced by bimanual examination. Under these circumstances an error in diagnosis may readily be made, and such an error might be more or less serious if Alexander's operation or the application of a pessary were being contemplated.

When no evidence of adnexal disease is made out, the presence of adhesions can usually be detected by the pain that is elicited when the uterus is drawn away from the rectum by the examining finger placed behind the cervix.

The **symptomatology** of adherent retroversion is identical with that of pelvic inflammation. Backache and pelvic pressure symptoms are less pronounced than in retroversion from relaxation, because, as a rule, there is little or no descensus of the uterus.

The **treatment** of adherent retroversion is included in that of pelvic inflammation. In choosing the best method of replacing the uterus one must consider the possible effect of postoperative adhesions. Operations of the reduplicating type, such as Coffey's and Baldy's, do not lift the uterus sufficiently away from the posterior culdesac, so that adhesions more readily form. Moreover, these operations do not give sufficient supporting power to insure resistance against the contraction of new adhesions.

Experience has shown that operations of the Gilliam type, performed for adherent retroversion, are sometimes followed by very extensive adhesions.

The most satisfactory operation for the avoidance of troublesome postoperative adhesions is Olshausen's anterior fixation of the round ligaments.

### RETROVERSION DUE TO DISPLACEMENT BY TUMORS

The uterus is less commonly displaced backward by tumors, for the majority of pelvic tumors lie in the posterior culdesac and tend to force the uterus upward and forward.

Pedunculated fibroids growing from the anterior uterine wall may cause retroversion, as may ovarian tumors with long pedicles which occasionally rest in the uterovesical space. On rare occasions pus-tubes become adherent to the anterior wall and force the uterus backward as they develop.

A uterus that has been forced back by a tumor will sometimes spring back spontaneously to its normal position after removal of the tumor, even when the displacement has been maintained for a considerable length of time. As a rule, however, the retroversion is permanent, and the removal of tumors that dislocate the uterus should always be followed by a proper supporting operation.

## PROLAPSE AND PROCIDENTIA

### PROLAPSE

Prolapse of the uterus is usually a second phase of retroversion as a result of relaxation, and its causes are the same, namely, child-bearing and physiologic insufficiency of tissues. Occasionally prolapse is the result of downward pressure from an abdominal tumor or from ascites. In the very great majority of cases, however, prolapse is the result of child-bearing, and is far more frequent than is commonly supposed. It is almost constantly associated to a greater or less degree with vaginal relaxation, and is a factor to be reckoned with in all reconstructive surgery for the repair of injuries due to childbirth.

As has been stated in the definition, prolapse relates to all forms of descensus from the normal level of the uterus to a point where the cervix reaches the vaginal introitus. Under normal conditions the uterus possesses some mobility in the direction of the pelvic outlet, and under the influence of forced abdominal pressure there is a certain amount of physiologic descensus. The uterus, however, should return immediately to its normal position after release of the abdominal pressure. The normal excursion of the uterus varies somewhat in individuals. Descensus is pathologic when it exceeds the normal limits, or where, after the continued abdominal pressure of standing, walking, working, etc., the uterus does not return to its physiologic level.

Prolapse is in most cases associated with retroversion, to which it is a secondary stage in the process of pelvic relaxation. It may, however, exist with the body of the uterus in the forward position. The entire uterus may sag downward toward the pelvic outlet without changing the direction of its craniocaudal axis, or the fundus may remain in normal position while the cervix swings forward toward the bladder. The latter condition is due to abnormally lax uterosacral

ligaments. This form of prolapse may occur after an anterior suspension of the uterus.

Prolapse is associated with most cases of relaxation of the vaginal walls, especially with the anterior wall, for, on account of the intimate attachment of the bladder to the cervix, prolapse naturally drags the bladder down with it and favors the formation of a cystocele. Per contra, the presence of a cystocele usually indicates an associated prolapse. However, the two conditions do not

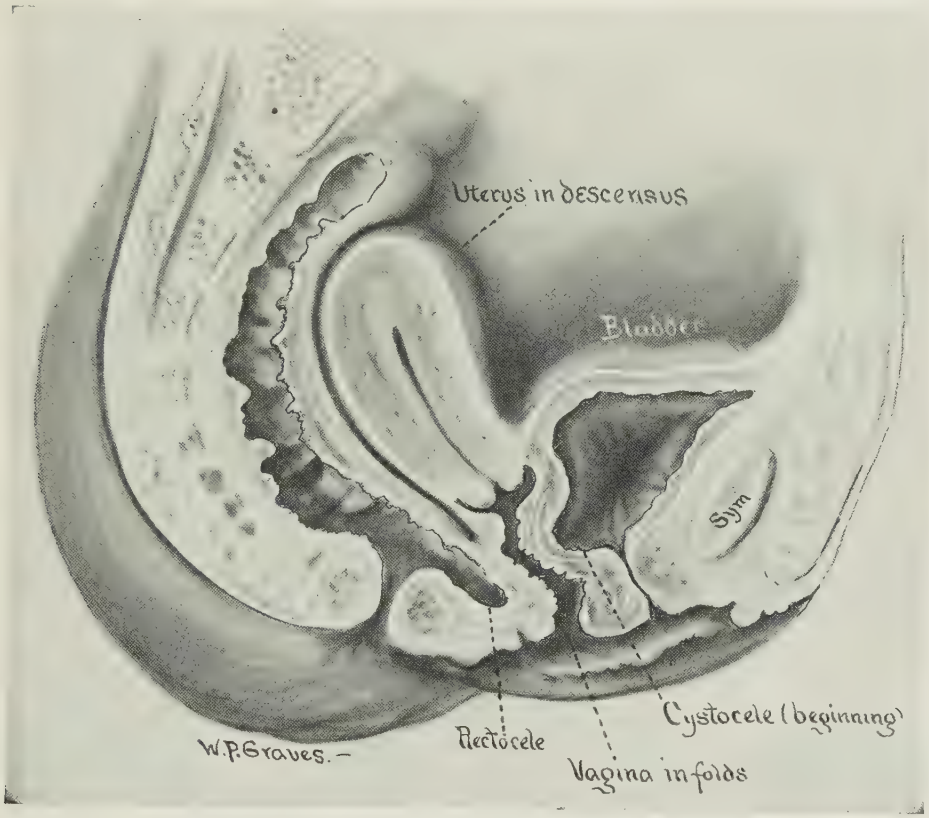


Fig. 213.—Retroversion and Descensus of the Uterus Toward the Vaginal Orifice. The vaginal walls are relaxed, with prolapse of bladder and rectum (cystocele and rectocele).

necessarily go hand in hand, for cystocele is occasionally found without prolapse, especially when it occurs in nulliparous women.

Prolapse may be present with anteflexion in those cases in which the anteflexion exists in combination with retrocession. In fact, retrocession implies a certain degree of prolapse. This subject will be discussed under the heading of Anteflexion.

**Diagnosis.**—The existence of a prolapse is often sufficiently evident from a history of pelvic pressure, especially if the symptoms date from childbirth. The diagnosis is made in the dorsal position by placing the examining finger on

the cervix and requesting the patient to bear down, as in the act of defecation, when the downward excursion of the uterus may be noted. It is sometimes difficult to get a patient to exert abdominal pressure in this way, and it is then necessary to make the examination with the patient in the standing position.

In both tests there may be an error, for the amount of prolapse in the same patient is not always constant. After fatigue from long standing the uterus may be several degrees lower than after rest in bed. It is important to know the lowest point to which the uterus may descend. Another error is sometimes made in examining a patient from whom a pessary has just been removed, for the prolapse may not become evident until the patient has been about on her feet for some time.

Very often the full extent of the prolapse is not apparent until the patient is anesthetized and the cervix is drawn downward toward the vaginal outlet. In determining the degree of prolapse with the patient under anesthesia it is important to be familiar with the amount of downward traction that the normal uterus will undergo. This varies in different women and is sometimes considerable.

**Symptoms.**—The symptomatology of prolapse has already been described under Retroversion, for it is the descensus which almost necessarily accompanies retroversion that causes the most important symptom, *pelvic pressure*, with its train of nervous and constitutional complaints.

The severity of the pressure symptoms does not necessarily correspond to the amount of prolapse, for some women with very marked descensus, even to the degree of procidentia, suffer little or no discomfort, while in others very moderate prolapse may cause distressing results. These, however, are the exceptions, and, as a rule, the relationship between the symptomatology and the anatomic position of the uterus is fairly constant.

It is important to remember that in patients suffering from the lacerations of childbirth the symptoms of pelvic pressure and weakness are due chiefly to the descent of the uterus and not to the tears of the cervix and perineum. This significant fact is referred to again under the subject of Lacerations.

**Treatment.**—Prolapse of the uterus may be treated palliatively with vaginal supports or radically by surgical operation.

The application of vaginal tampons gives temporary relief, but the long-continued use of tampons is undesirable. In prolapse pessaries have a wider field of usefulness than in uncomplicated retroversion. They are of especial advantage in treating elderly women with uterine atrophy, in whom there is some contra-indication to surgical operation. In prolapse of the pregnant uterus pessaries are an absolute necessity. In women of the child-bearing period who wish more children before going through a radical reconstructive operation they are also valuable.

Pessaries relieve prolapse by sustaining the vault of the vagina and by stretching out the vaginal walls so as to take up the slack caused by their relaxa-

tion. The counter-support of the pessary is against the two columns of the arch of the pubes.

If the pessary causes a retroflexion of the uterus this form of treatment is contra-indicated. In women after the menopause with genital atrophy the uterus gives no trouble, for it is not large or heavy enough to become retroflexed over the upper pole of the support. Pessaries are, therefore, much more applicable to elderly women than during the child-bearing period.

In using pessaries after the menopause it is important to pay special attention to cleanliness by douching and occasionally removing and scrubbing the pessary. The senile vaginal membrane is thin, easily excoriated, and prone to plastic inflammation, and pessaries are apt to become covered with irritating incrustations deposited from the vaginal secretions.

It is best when possible to use hard-rubber pessaries, especially in elderly women, as the soft-rubber varieties become very foul even with careful attention.

Moderate degrees of prolapse are sometimes spontaneously cured by atrophy and shrinking of the parts after the menopause. This spontaneous cure is, however, not to be relied upon, for more often the symptoms of prolapse are increased after the menopause is established.

**Surgical Treatment.**—When surgery is feasible, operative measures for prolapse are usually to be recommended, for in this way alone can the patient be radically cured. As prolapse is usually one of several manifestations of damage done by child-bearing, its treatment is in most cases only one of several procedures, each one of which is necessary for the complete cure of the patient. One or more of the following conditions may be present: lacerated cervix, cystocele, lacerated perineum, and diastasis of the abdominal recti muscles. Of all these, prolapse is the most important, for it is conducive of the most serious symptoms.

The methods of treating the other injuries of childbirth are referred to elsewhere. Surgical measures for treating the prolapsed uterus are extremely numerous. They may be divided into vaginal operations which seek to build up a support from below, and abdominal operations by which the uterus is restored to position by some form of artificial suspension. Vaginal operations, in general, are less efficacious than those of the abdominal type.

The abdominal operations for prolapse are, for the most part, identical with those for retroversion. It should be remembered, however, in operating for prolapse that the operation must not only serve to keep the uterus forward in anteversion, but that the suspension must take the place of the lost strength of the pelvic diaphragm, and must, therefore, be capable of sustaining the weight of the pelvic organs and resisting abdominal pressure. Some of the operations recommended for retroversion are not always to be relied upon for prolapse. The operations of the reduplicating type (Wylie's, Coffey's, Baldy's) have not sufficient sustaining power, and are unreliable if the uterus is heavy or if the prolapse is marked.

The operations of the Gilliam type are efficacious in suspensory power, but

do not control sufficiently well the position of the uterus, for by these operations the uterine body is apt to be faced toward the abdominal wall and the cervix tilted forward toward the pubes.

The best operation in our experience is that of the Olshausen type. The suspensory effect of the artificial adhesions created by this operation can be very accurately regulated. If the uterus is large and heavy or there is marked prolapse, a more powerful attachment is gained by passing the ligatures through the bases of the round ligaments, even including the uterine tissue itself. The size and strength of the artificial adhesions may be governed by the amount of contiguous peritoneal surfaces included in the ligatures, while the amount of reduction of the prolapse can be regulated by the point of attachment on the anterior abdominal wall.

By attaching the uterus sufficiently high on the abdominal wall the tendency of the cervix to swing forward is usually overcome, especially if the operation for cystocele, described on page 650, is performed at the same time. It is occasionally necessary to shorten the uterosacral ligaments to prevent the forward sag of the cervix.

In some cases of prolapse suspension of the uterus to the abdominal wall is not symptomatically successful. These are the cases of large permanently hypertrophied uteri, associated with thin, flabby abdominal wall and diastasis of the recti muscles. The weight of such a uterus from its new attachment causes symptoms even more troublesome than did the preceding prolapse. In this type of case the interposition operation of Watkins and others is applicable. We, however, would prefer to remove the uterus, employing the technic recommended for operations for procidentia (see page 744). Patients with this type of prolapse are usually multiparous worn-out women, to whom the removal of the uterus is a blessing.

The question of operating on women with prolapse who are likely to have more children is one which the surgeon has frequently to meet. This must be decided chiefly on the ground of the severity of the symptoms. Where there is much disability or great nervous disturbance it is best to advise operation, even at the risk of a later pregnancy and the possible chance of another operation for lacerations. If the operation for prolapse is done properly the patient can be assured the chances of dystocia, or recurrence of the prolapse after childbirth, are exceedingly small. She should, however, be told that there can be no guarantee against new lacerations of the cervix or perineum.

If symptoms are not too severe, and there is reasonable expectation of an early pregnancy, the patient should be treated palliatively and operation deferred.

The question of operation sometimes arises where there is considerable prolapse, but no symptoms. If it is apparent that the condition is likely to get worse, operation is advisable. If the prolapse seems to have reached its limit, the decision must be conservative. Judgment as to the future outcome of a given case is only gained by experience.

### PROCIDENTIA

Procidentia, as we have defined it, relates to an extreme degree of prolapse, and is applied to the condition in which the cervix extrudes from the vaginal introitus. It may seem somewhat arbitrary to make a sharp distinction between partial prolapse and procidentia, as they are different stages of the same process. The distinction, however, is convenient, as there are definite clinical differences between the two conditions.

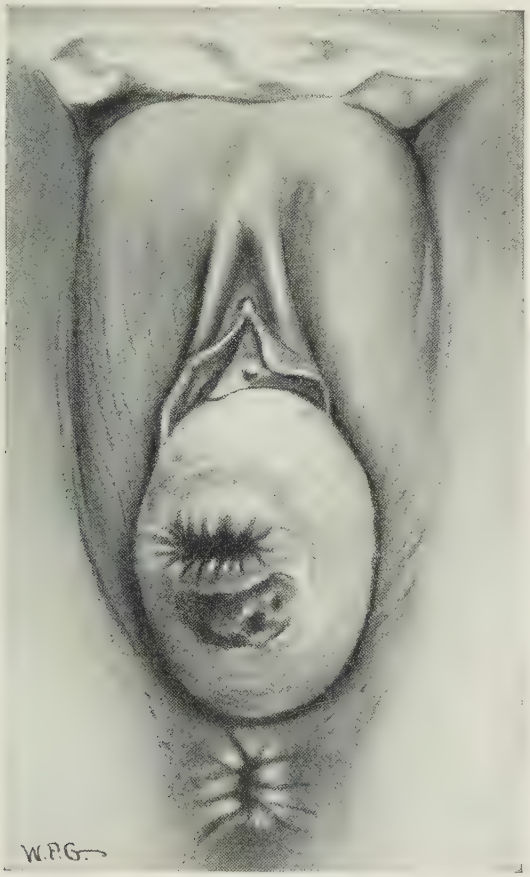


FIG. 214.—PROCIDENTIA.
Elongated cervix ulcerated. (Drawn after an illustration by Watkins.)

Procidentia, though it may occur at any age from twenty-five on, is more commonly an affliction of middle or later life. It is, as a rule, very gradually developed, the condition being accelerated by the physiologic weakening of the pelvic supports that occurs at and after the menopause. Rarely it may be seen in young women a few months after labor.

The change from prolapse to procidentia—*i. e.*, the protrusion of the cervical orifice beyond the vaginal introitus—sometimes gives the patient the impression

that the condition has developed suddenly, especially if the prolapse has not been noticed or if the perineum has been sufficiently small to obstruct temporarily the onward progress of the down-coming cervix. It should be remembered, however, that the presence of a procidentia indicates a gradual and usually slow progress. It is not brought on suddenly from a normal condition by falls, jars, and other forms of traumatism.

The existence and extent of procidentia are not necessarily dependent on the number of labors through which the patient has passed, but rather on the individual character of the pelvic supporting tissues. It is a noticeable fact that

Fig. 215.—Procidentia. Typical Case.

the mothers of very large families often suffer very little damage from their repeated labors, while other women, with a very limited number of childbirths, may exhibit extreme relaxation.

Congenital procidentia is a term somewhat improperly applied to nulliparous women who develop the condition. It is implied that there exists a congenital-tissue deficiency in the pelvic supports, but not that the procidentia appears in infancy. It may come to notice in comparatively young women, often not until the approach of or even after the menopause.[1] In the congenital type the descent represents chiefly a continued elongation of the cervix. As there have

[1] Pollock reports a case of procidentia in a girl of thirteen.

been no previous lacerations, cystocele, rectocele, and hypertrophy of the cervix are less marked than in the ordinary procidentia that results from childbirth.

The extrusion of the cervix in procidentia is in most cases primarily due to its elongation. This lengthening process of the cervix occurs in nearly all cases of marked prolapse, and is probably brought about by the effect of abdominal pressure on the bladder, which, by its attachment to the cervix, gradually draws the cervix out into an attenuated cord. The cervix may reach the length of 4 or 5 inches, and can be felt by rolling the extruding mass between the thumb and forefinger. The external end of the cervix usually becomes hypertrophied, sometimes to a great extent. The lower extremity of the bladder averages from $\frac{1}{2}$ to 1 inch from the border of the anterior lip of the cervix and represents a large diverticular pouch. Behind the cervix is another pouch, which is the prolapsed culdesac of Douglas. Rectocele may or may not be present, but usually is to some extent. The levator ani muscles are always widely separated, and usually atrophied as a result of the wedge-like pressure of the extruding mass.

The vaginal membrane covering the extruded parts attains a characteristic dry, cornified surface. On the cervical lips and sometimes on other portions of the mass are often seen decubitus ulcers with sharply defined edges and granulating surfaces covered with yellowish sloughs. To one unaccustomed to the appearance of procidentia a severe case with ulcerations is an alarming sight, and many times the diagnosis of malignant disease is made. It should be remembered, however, that notwithstanding the traumatism the cervix receives, procidentia rarely results in carcinoma.

As a rule, the fundus of the uterus does not extrude from the vaginal outlet, the increase in the length of the procidentia being due to the gradual elongation of the cervix. Occasionally the entire body of the uterus with its appendages may be included in the mass (Fig. 212).

An important feature of the pathologic anatomy of procidentia is the separation of the vaginal wall from its attachments to the rami of the pubes. These attachments are a very important element in the support of the uterus, and the amount of descensus of the uterus depends chiefly on the degree of their separation. In extreme forms of procidentia the vagina is completely detached from the pubic rami, a point of significance in the matter of treatment.

A special form of procidentia is that which results from an improperly performed hysterectomy, by which the vault of the vagina is not adequately suspended. This may follow either a supravaginal or complete hysterectomy, but is more frequently seen after the latter. In this form of procidentia the vagina is turned inside out, the bladder coming down with the anterior wall.

The **diagnosis** of procidentia is usually perfectly obvious. It should rarely be confused with cancer, but if the ulcerations are at all suspicious a specimen should always be removed and examined microscopically. It is of the utmost importance to reduce the procidentia and make a bimanual examination, as the condition may be caused either by pregnancy or a pelvic tumor or by ascites.

**Symptoms.**—As has been stated before, the symptomatology of prolapse of the uterus is not always proportionate to the amount of descensus of the uterus, and this is noticeable in procidentia, for some women with very marked falling of the womb have astonishingly little disturbance beyond the discomfort of the prolapsed mass between the thighs. Many women will endure a procidentia for years without complaint.

Just why some patients with moderate grades of prolapse often suffer greater sense of pressure and more serious nervous reaction than do some with extreme descensus has not been entirely explained. No doubt the personal equation is an important element, for it is a matter of common observation that women who go for years with a procidentia without impairment of their normal activities are of the strong self-reliant type, while those in whom moderate prolapse produces serious symptoms can usually be shown to be naturally of unstable physical and nervous equilibrium.

On the other hand, the suffering from procidentia may be extreme, and patients are sometimes entirely incapacitated, even from walking. Nervous manifestations may be severe, even to the point of insanity, especially in cases of procidentia following hysterectomy. In the latter class the psychic element resulting from disappointment at the failure of the operation plays a significant part.

Urinary symptoms are common owing to inability completely to evacuate the bladder. Constipation is also frequently present, especially if there is a rectocele. Sometimes neither the act of urination nor of defecation can be accomplished without manual reduction of the prolapsed parts.

Bleeding and a foul discharge may result from the ulceration of the surface, and are signs which often lead to the diagnosis of cancer.

The **treatment** of procidentia is either palliative or surgical. As procidentia often occurs in elderly or aged women in whom a surgical operation might be dangerous, palliative treatment is not infrequently indicated. This consists chiefly in the use of various forms of pessaries and uterine supports. Hard-rubber pessaries are the best to use if they can be fitted properly. The particular form of pessary can only be determined by trial. The soft-rubber doughnut pessaries become foul very quickly, but sometimes it is necessary to use them.

Many cases of procidentia cannot be kept reduced by any of the pessaries in common use. This is particularly true when the vaginal walls roll out in voluminous folds, carrying the pessary with them, so that there is no opportunity for it to engage behind the pubic arch. The only support which can hold up such a uterus is the cup-pessary, fitted with a stem and harness. This type is uncomfortable and almost sure to cause ulceration, and should rarely be employed. Some women are able to keep fairly comfortable by wearing a very tight perineal bandage with a supporting pad.

At the present day surgical treatment is much more successful than formerly. Most cases can be completely cured by operative methods, while all cases can be assured of relief. The results of surgery are so satisfactory that operation

should always be advised except when there is some strong contra-indication in the patient's general health.

There are numerous excellent operations for procidentia. Every gynecologic surgeon of experience has his individual technic, and it would be impossible in this work to include all the various methods that give good results. Several of the operations in common use are described in detail in the section on Surgical Technic. It may be said, in general, that the best operations now used can be divided into two classes—those that employ the interposition principle, and those that depend on artificial suspension from the abdomen.

By "interposition" is meant the separation of the uterus from the bladder, rotating the fundus far forward, and stitching the bladder on the posterior surface of the uterus. The uterus thus acts as a support to the bladder, reducing the cystocele.

The operation is described in detail on page 747.

To Dr. Watkins, of Chicago, is due the chief credit of this operation. The principle is extensively used in the European clinics and it has many adherents in this country. Those who use the operation report excellent results.

The principle of suspension is also widely used in this country, though in its use there is a great variety of technic. The author favors this principle, and a detailed description of the operation used by him is given on page 696. This operation involves, first, an amputation of the elongated cervix, plastic repair of the cystocele, and repair of the relaxed perineum. The second part of the operation consists in performing a supravaginal hysterectomy, attaching the remaining cervical stump to the broad ligaments, interposing the cervical stump under the bladder, and then attaching it to the anterior abdominal wall.

Other operations described in the section on Technic are those recommended by Goffe, Baldy, Crile, Mayo, etc.

The operative methods thus far referred to practically preclude a later pregnancy, though some cases of successful childbirth have been reported following the interposition operation.

Procidentia may occur in comparatively young women who wish more children. These patients can be greatly relieved by the performance of an operation similar to that recommended for partial prolapse, and yet be left in a condition in which the danger of serious dystocia is practically absent. The operation, as already noted, consists of plastic repair of the cervix, anterior wall, and perineum, together with a suspension of the uterus, preferably by the Olshausen method.

The cervix is not so apt to be elongated in younger women, but it may be. If it is necessary to amputate it, the operation of Hegar (described on page 636) is the best to employ, as by this method exact approximation can be attained with first-intention healing. It is of great importance to avoid the formation of scar-tissue, which may serve either to prevent impregnation or, if conception does take place, to interfere seriously with childbirth.

## ANTEFLEXION

The uterus is normally anteflexed at the junction of the cervix and fundus. The term "anteflexion," however, is commonly used to denote an abnormally sharp angulation. It is difficult to state precisely the limit of normal anteflexion, for what may be normal in one individual might be abnormal in another. It is usually stated that if the angle between cervix and body is less than 90 degrees it is pathologic. The angle may be so acute that the fundus and cervix are nearly parallel. The cervix is usually abnormally long, and may equal or even exceed the length of the fundus.

The uterus may acquire anteflexion by the pressure of overlying tumors, by contracting adhesions, or by relaxed supports. The first of these causes is not common. Contracting adhesions may produce anteflexion by forming on the anterior wall and drawing the fundus forward, or they may form on the posterior wall and draw the center of the uterus backward, while the fundus is held forward by its ligaments. Adhesions are a rare cause. Relaxation of the uterine supports sometimes acts in such a way as to allow the uterus to sag back in retrocession, the fundus, however, being held forward by the round ligaments. This is quite common. In the greatest number of cases anteflexion is the result of a faulty development, and is usually associated with other defects in the uterus. The typical anteflexed uterus is hypoplastic and the cervix is long and conical. The uterus, as a whole, in most cases lies abnormally far back in the hollow of the sacrum, in the position already described as that of retrocession. The cervix points either in the direction of the vaginal axis, or forward toward the anterior vaginal wall. This form and position of the uterus is that which is normally found before puberty. The condition is, therefore, one of infantilism.

Other evidences of hypoplasia are also frequently found, as a short anterior or posterior vaginal wall, short uterosacral ligaments, infantile type of ovaries, etc.

Besides the local hypoplasia of the pelvic organs the individual may exhibit evidences of infantilism in many parts of her physical make-up. On the other hand, the deficient development may appear only in the pelvic organs of an individual otherwise fully matured.

In the severe cases of anteflexion there is usually to be found at the internal os a cicatricial thickening which produces a certain amount of stenosis of the canal. This occurs more often on the posterior wall, but may be on the anterior, or it may involve the entire circumference as an annular constricting band. The significance of this process is discussed elsewhere.

The small anteflexed uterus feels, on examination, to be rather firm and unyielding, but when the patient is anesthetized it is found to be softer and more flaccid and with less erectile power than the normal uterus under like conditions. This would indicate a deficiency in the musculature. This is another evidence

of infantilism, for it is known that in the uterus before puberty the connective tissue predominates over the muscular tissue, whereas in the properly developed uterus the reverse is true.

**Symptoms.**—Anteflexion may exist without symptoms, but it is usually associated with either dysmenorrhea or sterility, or both. There seems to be no doubt that these symptoms are in some way the mechanical result of the angulation and constriction of the uterine canal, but just how they are produced has not yet been satisfactorily explained. The relationship of anteflexion to dysmenorrhea and sterility is dwelt on in the sections on those subjects.

The retrocession of the uterus commonly met with in anteflexion often produces symptoms identical with those from retroversion, and for the same reason. In fact, the cervix, both in retroversion and retroflexion, is practically in the same position. Hence it is that patients with anteflexion often complain of backache and pain in the sides of the pelvis, the latter symptom being due to stasis of the veins in the broad ligament.

It has been our experience that patients with anteflexion are especially prone to chronic appendicitis, but no adequate explanation of this can be given.

Women in whom anteflexion produces dysmenorrhea nearly always have an unstable nervous equilibrium. (See Dysmenorrhea and section on Neurology.)

The **diagnosis** of anteflexion is readily made by passing the examining finger along the anterior wall of the cervix and pressing deeply into the anterior vault of the vagina, when the angle between cervix and body of the uterus can always be felt. Mistakes are, however, frequently made on account of the retrocession of the uterus and the forward direction of the cervix, which on hasty examination give the impression of a retroversion. A myoma centrally placed on the anterior wall of the fundus may simulate closely an acute anteflexion.

The **treatment** of anteflexion of the uterus is mentioned in detail in Part III. It comprises four methods: the use of stem-pessaries, instrumental dilatation, plastic operations on the cervix, and suspension of the uterus from the anterior abdominal wall. By the orthopedic or pessary method a straight or slightly bent canalized stem, usually made of hard rubber, is inserted in the uterine canal, where it is kept for six weeks or two months. Dysmenorrhea and sterility are sometimes entirely cured by this measure, but it is to be remembered that it may cause infection of the tubes. The use of stem-pessaries sometimes permanently reduces the anteflexion, but frequently the uterus returns to its former position. The recurrence of the anteflexion is not always accompanied by a return of the symptoms.

Dilatation of the cervical canal should be done under an anesthetic, and is best performed with Hank's graduated dilators.

If a cicatricial band is present at the internal os the dilatation may be difficult. It is sometimes necessary to incise this obstruction with a bistoury. Simple dilatation is successful in a limited number of cases.

Plastic operations on the cervix are numerous, but, though occasionally successful, are rather unsatisfactory in their results. The operations most used are: the removal of a transverse wedge from the posterior wall of the cervix, the posterior discission, and the bilateral artificial laceration. These operations are described in the section on Technic.

*Suspension.*—It has been stated above that the musculature of the typical anteflexed uterus is lax and flaccid. The characteristic sagging back in the position of retrocession is, in reality, a condition of relaxation, differing only from congenital or developmental retroflexion in that the fundus points forward in relation to the cervix instead of backward. There may even be a limited amount of descensus. When the abdomen is opened the anteflexion may be completely reduced by drawing the fundus upward toward the wound in the abdominal wall. By suspending the uterus the angulation can be permanently reduced. This is best accomplished either by the Gilliam type of operation or by the Olshausen method, preferably the latter. In other words, anteflexion may be treated exactly as congenital retroflexion, and this is reasonable because the two conditions, from a pathologic standpoint, are nearly the same.

The results of the suspension operation for anteflexion are not always successful either for dysmenorrhea or for sterility, but in the experience of the writer they are considerably more satisfactory than those secured by the other methods mentioned above.

In all cases of anteflexion the presence of a cicatricial band at the internal os makes the prognosis worse as regards curing the symptoms. If the suspension operation is employed it should always be preceded by a thorough dilatation of the cervix.

## INVERSION OF THE UTERUS

Inversion of the uterus is due primarily to a relaxation of the uterine wall and most frequently occurs as a complication of childbirth. It may also result gradually from the traction of a submucous or pedunculated fibroid or from cancer, so-called onkogenetic inversion. That the condition even after childbirth is a rare one is shown by Jones' collected figures, which show an average of 1 case in 128,767 labors.

Inversion of the uterus is either acute or chronic, those cases which last a month or less being called acute, those seen at a period longer than this being regarded as chronic. Inversions from gynecologic causes—*i. e.*, the traction of tumors—are always of the chronic type.

The inversion is called "incomplete" when the fundus does not pass the cervix, and "complete" when it extends beyond this point. In very rare instances the inversion includes the cervix, so that the entire organ is inside out. Usually, however, the cervix remains as a sort of collar about the inverted fundus.

In all chronic cases the cervix is firmly contracted, while in the acute cases following labor it becomes contracted very quickly, from a few minutes to a

few hours (W. C. Jones). In acute cases the inverted fundus is large, but in the chronic form it may become markedly involuted (Hoover). Some cases of gangrene have been reported where the circulation has been cut off. If there is an associated prolapse or a pedunculated myoma the mass may extrude from the vulva.

The **symptoms** of acute inversion are shock and hemorrhage, cases of this kind being entirely within the sphere of obstetrics. The symptoms of chronic inversion are similar to those of prolapse.

The **diagnosis** in acute cases is usually unmistakable, but in the chronic variety it may offer considerable difficulty. The condition with which inversion is most apt to be confounded is that of a pedunculated fibroid. When the fibroid

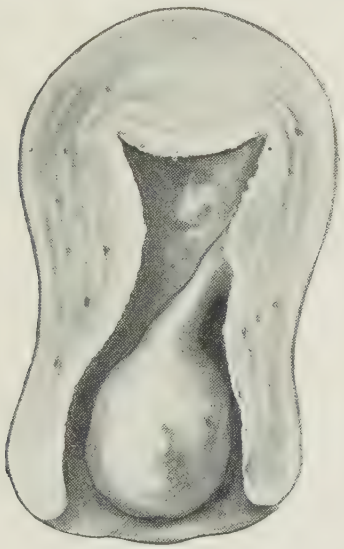

FIG. 216.—MYOMATOUS POLYP.
Distinguished from inversion by a deepening of the uterine canal.

FIG. 217.—MYOMA CAUSING INVERSION BY TRACTION.
Distinguished from simple polyp by shortening the uterine canal.

and inversion occur simultaneously the diagnosis is still more puzzling. W. C. Jones has offered an excellent means of differentiation in pointing out that the key to the situation is the length of the uterine canal, a fibroid always producing elongation; inversion always shortening it. The accompanying diagrams illustrating this point are adapted from Jones' article.

If the patient's abdomen is not too thick, the depression from the abdominal side caused by the inversion can be felt by bimanual examination.

The **treatment** of acute inversion is immediate manual reposition. If this is difficult, it is better, according to Küstner, to resort at once to the conservative method of operation described in Part III.

Surgical treatment of chronic inversion is either radical or conservative, the choice of which course is determined as in other uterine conditions. Thus, if

the uterus be studded with fibroids, or if there is suggestion of malignancy, or if the patient is past the menopause, extirpation of the uterus is indicated. This can be done by the abdominal or the vaginal route, the former being recommended because of the better opportunity of preventing a future prolapse of the vagina.

Of the conservative operations, that devised by Küstner and termed "colpohysterotomy" is the classical method, though it has been modified to some extent by others. Two forms of operation are described in the section on Operative Surgery.

Vaginal amputation of the extruded fundus is sometimes done, but is an operation not to be highly recommended. The same may be said of reposition of the inverted uterus by the abdominal route.

# Injuries Due to Childbirth

## LACERATION OF CERVIX

Lacerations of the cervix usually result from childbirth, especially when there has been instrumental delivery. They are also caused by dilatation operations and instrumental abortions.

Tears of the cervix, as a rule, occur on one or both sides. Occasionally the posterior and, more rarely, the anterior lips are torn. If the laceration takes place in more than two places it is called stellate.

The surface of a cervical tear may heal over completely, leaving only a smooth cleft without further change in the cervix. Usually, however, lacerations produce certain pathologic conditions, the most important of which are eversion of the mucous membrane (ectropion), hypertrophy of the lips, erosion, and cyst formation of the Nabothian glands.

Eversion or ectropion results from a pouting of the cervical lips after laceration, by which the mucous membrane is allowed to roll outward toward the vagina. This condition of the mucosa is greatly aggravated by the various chronic inflammatory changes in the cervical tissues that are apt to ensue after laceration.

Hypertrophy of the cervix following laceration relates to an enlargement of the cervical lips, which sometimes is very great. This increase in size is due partly to an actual hyperplasia of the cervical connective-tissue stroma, partly to a chronic inflammatory infiltration, and partly to a general edema of the tissues. A further important factor in the enlargement of the cervix is dependent on the change in the endocervical glands. These glands, it will be remembered, are of a complicated racemose type, with small single ducts opening into the cervical canal. The ducts easily become obstructed with resultant cyst formation of the main portion of the gland. If a number of the glands become cystic the cervix may be enormously enlarged. The contents of the cysts consist primarily of true mucus from the secreting lining cells of the glands, but there is apt to be a mixed infection which adds products of inflammation and detritus to the mucous material. The mucous membrane of an everted cervix is practically always infected, and frequently shows microscopically a necrosis and desquamation of the superficial epithelium. If this condition becomes sufficiently extensive to be recognized by inspection it is termed "erosion." Erosion and ulceration of the cervix, as a result of a laceration and its attendant cervicitis, is not as common as is supposed. The everted mucous membrane has a deep red appearance, which, to the inexperienced eye, gives the impression of a loss of surface tissue. The diagnosis of "ulceration of the cervix" is, therefore, very often erroneously made. True ulceration where observed must always be regarded with concern, as it is likely to indicate some form of disease more serious than

simple cervicitis. Its appearance demands a removal of tissue for microscopic examination.

The spontaneous healing of cervical tears is often attended with dense scar-formation most marked in the angles of the lacerations. This scar-formation may extend out on the lateral walls of the vagina or upward into the parametrium. The contraction of the scar-tissue may immobilize the uterus to some extent, or cause version of the body to one side or backward.

**Symptoms.**—Lacerations of the cervix do not cause definite local pain, as the cervix is a peculiarly insensitive organ. The hypertrophy of the lips in-

Fig. 218.—Chronic Hypertrophic Cervicitis.

creases the weight of the uterus, and as there is usually some prolapse associated with severe lacerations, the sense of weight and pelvic pressure is often present. Backache is a somewhat inconstant symptom. If the uterus is immobilized by scar-tissue in the parametrium there is increased pelvic discomfort. Ectropion always produces leukorrhea and sometimes irregular bleeding.

Numerous so-called "reflex" disturbances from cervical tears have been described, such as headaches, pains in the spine, and various hysteric neuroses. These are undoubtedly secondary nervous manifestations of depleted health

caused by the damage to the pelvic organs in which the lacerated cervix is only one factor.

Laceration of the cervix sometimes causes sterility, probably as a result of the chemically changed secretions from the everted and inflamed mucous membrane which may be inimic to the life of the spermatozoa.

Women with deep tears extending to the internal os are very apt to have multiple miscarriages, probably due to interruption of the normal function of the uterine musculature.

The **diagnosis** of lacerated cervix is usually obvious both to touch and sight. The erosion and eversion of the mucous membrane may simulate the ulcerations of tuberculosis and syphilis, but these latter are very rare.

It is of the greatest importance to distinguish between severe laceration and cancer of the cervix. It is sometimes very difficult to make a diagnosis without the removal of a section for microscopic examination. To the touch the hard hypertrophied lips of cervicitis, made irregular and nodular by the Nabothian retention cysts, may be almost indistinguishable from cancer. Bleeding from contact of the examining finger which is so characteristic in cancer is sometimes met with in cases of laceration with erosion. On inspection the Nabothian cysts can usually be readily seen. The presence of these cysts, as a rule, is evidence against cancer, but this is by no means always the case.

It should be remembered that cancer usually originates in one of these lacerated everted cervices, so that on the least suspicion a specimen must be removed for microscopic examination. In an early cancer of the cervix the point of origin is not always distinguishable. In a doubtful case, therefore, it is best to remove several pieces.

Parametrial cicatrices sometimes obscure the diagnosis, for it immobilizes the uterus and gives to the examining finger a sense of indefinite resistance in the adnexa closely resembling a chronic salpingitis with adhesions.

**Treatment of Lacerated Cervix.**—Nearly every woman who bears a child has some laceration of the cervix. Only those require treatment that give definite symptoms, or that by their appearance threaten the development of a cancer. Unless the tears are small, it is advisable always to repair the cervix as a routine during plastic operations of the vagina, and to examine microscopically the tissue removed.

Eroded and inflamed cervices may be temporarily improved by local applications such as iodin, ichthyol, and glycerin tampons, etc., but they cannot in this way be permanently cured.

Surgical treatment is based usually on the operation devised by Emmet many years ago and never improved upon. This consists in denuding the edges of the clefts caused by the laceration, and sewing the denuded surfaces together (see page 630). If there is great hypertrophy of the lips or extensive scar-tissue formation it may be necessary to resort to other measures, as the removal of transverse wedges from the lips (see page 635) or to amputation of the entire cervix.

Unless the cervix is elongated, as in prolapse and procidentia cases, it is best to perform a tracheloplasty rather than amputation if there is likelihood of later child-bearing.

If amputation of the cervix is necessary, Hegar's method gives the best results (see page 636), as it secures a more accurate approximation of the wound edges than does any other form of operation.

## CYSTOCELE[1]

Cystocele is a descent of the bladder toward the introitus caused by relaxation of the anterior vaginal wall. In the great majority of cases cystocele is one of the results of child-bearing, though it may occur in nulliparous and even in virgin women. When not the result of the injuries of childbirth it is due to congenital tissue weakness.

Cystocele is nearly always associated with a greater or less degree of prolapse. In general, the two conditions are roughly proportionate to each other. This is due to the intimate attachment which the bladder has to the anterior wall of the cervix uteri, so that neither organ can prolapse without a tendency to drag the other with it. Cystocele, especially of the congenital type, is occasionally seen with little or no prolapse of the uterus, but this is uncommon, and may be regarded as a true hernia of the bladder. We do not, however, see prolapse of the uterus without some descent of the bladder. This is a fact of great practical importance in the matter of treatment, both of cystocele and prolapse of the uterus.

Cystocele usually begins in the upper anterior part of the vagina near the attachment of the bladder and cervical wall. Where the vaginal wall has once lost its integrity the cystocele is gradually increased by abdominal pressure, and in time appears at the introitus. The exertion of abdominal pressure by straining or standing causes the anterior wall, with the bladder behind it, to protrude into the world. The constant application of the force of abdominal pressure acts as a drag on the cervix of the uterus, which becomes lengthened and attenuated, until it may reach the stage of procidentia. The force of abdominal pressure serves more and more to drag the vagina away from its attachments to the rami of the pubes. As this attachment is one of the most important supports of the uterus, the uterus itself prolapses increasingly.

The descent of the bladder may include the urethra, and when this takes place the condition is termed "urethrocele." Urethrocele is usually only an incidental part of the process of cystocele, but it may occur alone.

If the cystocele extrudes constantly from the vagina the surface epithelium becomes dry and cornified, and if there is also procidentia it may become ulcerated.

The **symptoms** of cystocele are closely associated with those of prolapse of the uterus, the chief one being that of general bearing-down or pelvic pressure with tendency to fatigue. This might more properly be spoken of as an asso-

[1] For mechanism, see that of Prolapse.

ciated symptom, being due principally to the prolapse of the uterus. If the cystocele is advanced the patient is conscious of its protrusion, often regarding it as the womb. This annoyance may have a deleterious influence on the nervous system if the patient's mind becomes riveted on the local condition. The involvement of the neck of the bladder causes symptoms of urinary irritability and frequency, while the sacculated condition of the bladder walls prevents complete voiding, and thus produces stagnation and chemical changes in the urine. Relaxation of the urethra and neck of the bladder may cause partial incontinence, especially in old people. Incomplete voiding of the urine sometimes encourages a cystitis, though it is surprisingly uncommon.

The **diagnosis** of advanced cystocele is entirely obvious. The milder forms are diagnosed by feeling the anterior wall near the cervical reflexion, and requesting the patient to bear down as in the act of defecation. There is a normal amount of bulging of the anterior wall, just as there is a normal amount of descent of the uterus, and this must be learned by experience. Under ether the amount of cystocele present is demonstrated by grasping the anterior vaginal wall with two pairs of thumb forceps and drawing it forward toward the opening. The difference between the normal and pathologic amount of slack is easily learned.

The diagnosis of urethrocele is determined by passing a sound into the urethra. It should be remembered that there is apt to be a considerable hypertrophy of the anterior vaginal wall at the level of the urethra. This hypertrophied protrusion is sometimes taken for a cystocele or for urethrocele.

**Treatment.**—The following remarks on the treatment of cystocele relate to the method of treating genital prolapse by *suspension*, and are not entirely applicable to the *interposition* method, which involves a different mechanical principle. A description of the latter technic is given on page 650.

In treating cystocele, one should always remember its close relationship to prolapse of the uterus, and regard the two conditions as phases of the same process. Failure to appreciate this fact led some of the older operators to regard cystocele as incurable. This is because the simple performance of a plastic operation on the anterior wall of the vagina, without permanently correcting the associated prolapse of the uterus, will almost certainly be followed by a recurrence of the cystocele.

On the other hand, however, the reduction of the prolapse of the uterus will, at the same time, reduce milder grades of cystocele without plastic operation on the cystocele.

In treating cystocele, therefore, it is a fundamental principle that the most essential part of the operation is the elevation of the cervix, for it is to its cervical attachment that the bladder chiefly owes its position in the pelvis. The elevated cervix does not take up all the slack of the relaxed anterior wall, and this must usually be corrected by a plastic operation. If the operation is done in this way the reduction of the cystocele will remain permanent.

Plastic operations for folding in the redundant anterior wall are numerous.

A useful operation for this purpose is described on page 650. This operation, to be successful, must in most cases be supplemented by some form of suspension which will elevate the cervical attachment of the bladder. This is accomplished by the methods described under Prolapse and Procidentia of the Uterus.

A special point to be noted in the operation described for cystocele is the method of treating the upper portion of the cystocele near the cervical reflexion. The denudation is carried out more widely than at the lower portion, so that when the vaginal flaps are approximated a firm bridge is made across the front of the cervix, carrying it backward toward the sacrum. This serves to correct the tendency of the cervix in partial prolapse to swing toward the pubes.

The treatment of cystocele by the interposition method involves a separation of the bladder from the uterus, and then transposition of the bladder to the posterior surface of the uterus. In this way the uterus is brought under the bladder and supports it from below.

## LACERATED PERINEUM

In order to understand the mechanism of perineal lacerations it is important to have a clear idea of the essential points in the anatomy and function of the perineal muscles. Unfortunately, the subject is not an easy one, for the parts are very difficult of dissection and the descriptions of them are, for the most part, vague and misleading.

The most practical demonstration of the functional anatomy of the pelvic diaphragm which we have seen is that by Studdiford, published in Johnson's Surgical Therapeutics. His statement is so clearly expressed that we cannot do better than to quote it verbatim:

"The levator ani muscle, together with the strong fascia covering its internal and external surfaces, is conceded to be the essential part of the pelvic diaphragm, but there is no uniformity of opinion as to the relative value of the two elements, the mechanism of their action in giving support, and how they are affected by injury. The levator ani is a paired muscle which has its origin from the tendinous arch which extends from the lower margin of the pubes to the spine of the ischium, from the inner surface of the superior ramus of the pubes, and from the pubes parallel to the symphysis. The fibers coming from the pubes form a distinct muscular band, the pubococcygeus muscle, and are the most important part of the levator. The fibers from the tendinous arch, the ileococcygeal muscle, are slender fasciculi separated by small interspaces. The majority of the fibers from the tendinous arch are inserted into the lateral margins of the coccyx, some are joined with the muscles from the opposite side, and others are inserted into the anococcygeal ligament. The fibers of the pubococcygeus arising from the pubes pass directly backward, some of the fibers uniting with the fibers of the external sphincter. Others pass directly to the anococcygeal ligament, while still others join with the fibers from the opposite side posterior to the rectum, some of the fibers mingling with the longitudinal fibers of the rectum.

The muscle is in close relation with the side walls of the lower end of the vagina, its fibers mingling with the longitudinal fibers of the vaginal wall. The relation of the muscle to the external sphincter is of the utmost importance and is so intimate that separation by dissection is impossible. Functionally the two muscles must be considered together as forming a strong muscular band extending from the pubis to the coccyx, controlling and embracing the lower end of the rectum and attached to the side walls of the vagina. It is usual to describe the levator ani as a sling or horseshoe-shaped muscle. It would give a more correct idea of the structure were it described as V shaped, the angle of the V being much wider posteriorly where the muscles are attached to the ischial spines and narrowing as the anterior fibers (pubococcygeus) attached to the pubic bone are approached. The sides of the V have a slight convexity toward the median line, the apex of the V being the attachment to the coccyx. The open part of the V between the anterior portion of the pubococcygeus muscles is protected by the urogenital trigone made up of two strong layers of fascia, inclosing between them the deep transversus perinei muscles together with some involuntary muscle-fibers. The urogenital trigone is attached to the inner margins of the inferior rami of the pubes anterior to the tuberosities of the ischii, its sharp posterior border marking the anterior boundary of the ischiorectal fossæ. It is perforated by the vagina and urethra and fuses with the fascia covering these organs. The posterior surface of the trigone is in relation with the fascia covering both surfaces of the levator ani and gives support to the fibers of the pubococcygeus. The deep transversus perinei, rising from the inner surface of the tuberosity of the ischium between the layers of fascia and forming part of the posterior half of the urogenital trigone, is attached along with the anterior fibers of the external sphincter to the so-called central tendon of the perineum. It is this part of the perineum that I believe has been improperly described.

"In an article of mine in 1909 the importance of the *involuntary muscle-fibers* contained in the pelvic floor was emphasized. The study of these fibers was based not only on gross dissection, but on frozen sections and microscopic examination of the tissues from the cadaver and microscopic examination of tissue removed from the living subjects during operative procedure. These observations have been confirmed by study of dissections since that time. These investigations showed that the tissue lying between the halves of the levator ani and at the points of attachment of the anterior end of the external sphincter and to the deep transversus perinei muscles in the perineal body was made up largely of involuntary muscle-fibers. These fibers running in both a transverse and longitudinal direction are in close relation to all the muscles. So far as I have been able to determine, no fibers from the two halves of the levator ani muscle pass between the vagina and rectum. These involuntary muscle-fibers we consider important in the mechanism of the pelvic floor, their contraction tending to draw the two halves of the levator ani and the deep transversus perinei muscles toward the median line, thus placing these muscles in the most advan-

tageous position for action, and by drawing the anterior end of the sphincter forward aid the supporting power of the levator. These fibers undoubtedly increase in size and strength during the pregnancy, and account for the increased projection and thickening of the pelvic floor at that time. They also permit the dilatation of the pelvic floor at the time of labor and undergo involuntary changes after labor.

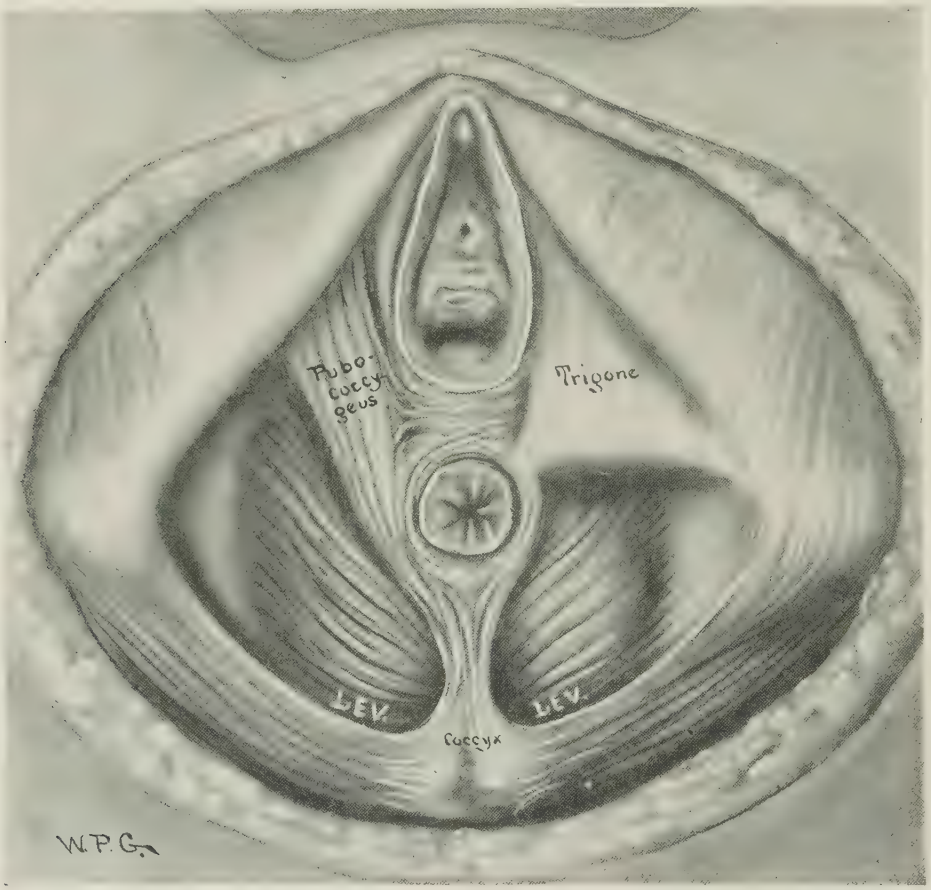


Fig. 219.—Semidiagram Showing the Relationship of the Perineal Muscles.

On the left is seen the fascial investment called the urogenital trigone. Behind the lower edge of the trigone lies the transversus perinei muscle not seen in the drawing. On the right the trigone and transversus perinei have been removed. The bundle of muscle-fibers which constitute the anterior part of the levator ani muscle and which are called the pubococcygeus muscle can be seen. The intersecting involuntary muscle-fibers which cross between the two pubococcygeus muscles are indicated in the drawing. Note the relationship of the pubococcygeus to the vagina and the sphincter ani.

"The force of the contractions of the levator ani are directed by the course of its fibers. In the upright position the fibers of the pubococcygeus run almost horizontal from the pubes to a line drawn between the tuberosities of the ischii which marks the posterior border of the urogenital trigone, to the posterior surface of which the fascia covering the muscle is attached. Posterior to this line

the fibers intermingling with the fibers of the external sphincter pass upward and backward to the coccyx. So that when contraction of the muscles takes place the involuntary fibers approximate the two halves of the muscles toward the median line, the urogenital trigone is pulled upward and forward, closing the vaginal slit. The exaggerated action of these involuntary fibers can be seen in cases of vaginismus. The lower end of the rectum is also drawn upward and forward, and the portion of the muscles posterior to the ischial tuberosities is supported by the upward and forward pressure of the obturator and gluteal muscles on the tissues filling the ischiorectal fossæ. Bearing in mind this relation of the structures of the pelvic diaphragm which is so essential to its proper action, it will be readily seen that the way in which such action could be most easily disturbed would be by injury to the tissues marking the junction of the

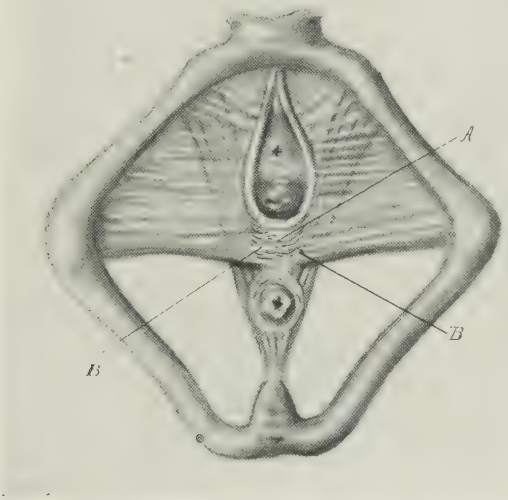


FIG. 220.—DIAGRAM SHOWING THE PUBOCOCCYGEUS PORTION OF THE LEVATOR ANI MUSCLES, THE UROGENITAL TRIGONE, AND THE EXTERNAL SPHINCTER.
*B, B*, junction of involuntary muscle-fibers, pubococcygeus, and urogenital trigone.

involuntary muscle-fibers, the urogenital trigone, and the fascia covering the pubococcygeus. It is at this point that lacerations of the pelvic floor usually occur, and the effect of such injuries is measured by the extent to which the relations of the various structures to each other are disturbed. Figures 219–222 give a diagrammatic representation of the effect of such injuries. A laceration in the median line through *A* that does not extend below the upper margin of the external sphincter involves some of the involuntary muscle-fibers and causes little disturbance of function and is easily repaired at the time of injury. Injury on one side allows the pubococcygeus on that side to sag away from the median line by the detachment of the involuntary muscle-fibers. If the tear extends through the skin, as it usually does, the relations of the pubococcygeus on that side to the external sphincter are disturbed and the sphincter is drawn toward the uninjured side. The deep transversus perinei and the urogenital tri-

gone on the injured side retract, pulling the pubococcygeus fibers outward, such retraction increasing in force if the fascia of the levator ani and the trigone are

FIG. 221.—LACERATION THROUGH RIGHT VAGINAL SULCUS.

On the left the relation of involuntary fibers, pubococcygeus, and trigone is intact. Note that on the right the pubococcygeus sags away toward the pubic bone. The sphincter is drawn toward the unaffected side.

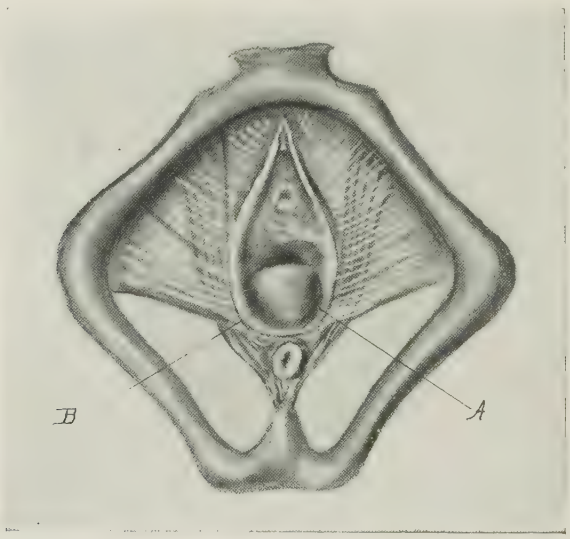


FIG. 222.—LACERATION THROUGH BOTH SULCI *A* AND *B*.

Both pubococcygeus muscles together with the urogenital trigone sag outward and retract toward the pubic bones. The external sphincter drops backward and toward the least injured side.

separated from each other. If the tissues on both sides are injured, the resulting disturbance of function of the pelvic diaphragm is more marked, the involuntary fibers are torn from the two halves of the pubococcygeus, and the muscles sag

away from the median line (Fig. 222). The retraction of the trigone occurs on both sides and the external sphincter drops downward and backward and is usually drawn toward the half of the pubococcygeus from which there is the least separation of the involuntary fibers. The posterior vaginal wall drops downward and backward posterior to a line drawn between the ischial tuberosities.

When these injuries occur during labor they allow the two halves of the pubococcygeus to separate as the birth of the presenting part takes place. I have never been able to demonstrate in either recent or old lacerations of the pelvic floor the rupture of the fibers of the pubococcygeus that is so graphically pictured in many text-books, and do not believe that it takes place except in badly executed forceps operations. I have seen cases in which the fibers of the pubococcygeus were torn close to their attachment to the symphysis during the withdrawal of the forceps blades. In two cases where brutal attempts at delivery by forceps had been made the fibers of the pubococcygeus were torn above the sphincter so that the ischiorectal fossa was opened. I believe that this opening into the fossa will occur whenever the fibers of the pubococcygeus near the perineum are actually ruptured.

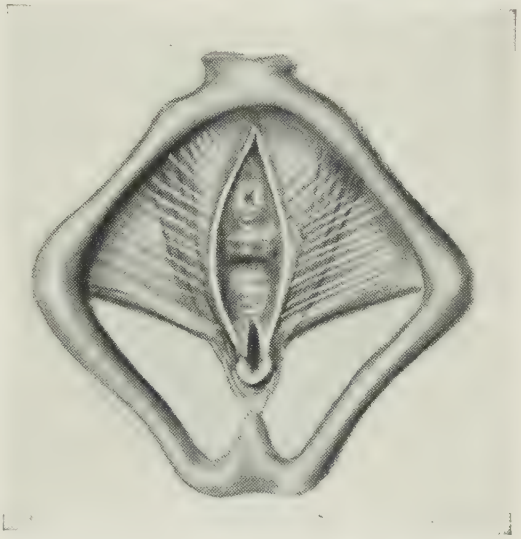

Fig. 223.—Laceration Through Sphincter.

In this case there is little damage to the pubococcygeus and trigone, so that there is less sagging and retraction than when the laceration has taken place in one or both sulci. It is also possible to have a laceration both through the sphincter and into one or both sulci.

"The effect of such injuries increases in direct proportion to the length of time during which they are allowed to remain unrepaired and the amount of intra-abdominal pressure to which they are subjected. The muscles atrophy from impairment of function. The fascia becomes stretched and the unsupported action of the sphincter allows the posterior vaginal wall and the rectal wall beneath it to prolapse. The gluteal muscles give some support for a time by pushing upward on the tissues of the ischiorectal fossæ, but sooner or later the fascia of the levator bounding the inner walls of the fossæ gives way under the strain and the upper angles of the fossæ become flattened and the support of the gluteal muscles is lessened or withdrawn. Where the tear extends through the external sphincter and its function is eliminated (Fig. 223) the sagging of the pubococcygeus is less in evidence because these muscles are relieved of the strain necessary for the maintenance of the action of the sphincter. The relaxation of the pelvic floor occurring in nulliparæ, or after labor in which there

has been no visible tear of the vaginal wall, is, in my opinion, due to stretching or rupture of some of the involuntary fibers. In nulliparæ this may result from poor development of these fibers, as it often occurs where the genital organs are also developed, or it may be caused by overstrain from excessive muscular action causing badly directed intra-abdominal pressure."

**Symptoms.**—The symptomatology of lacerated perineum is closely interrelated with that of cystocele and prolapse, with which it is usually associated as a part of a general process of relaxation. The rôle played by the lacerated perineum in the symptoms caused by this chain of lesions is less important than that of cystocele and prolapse.

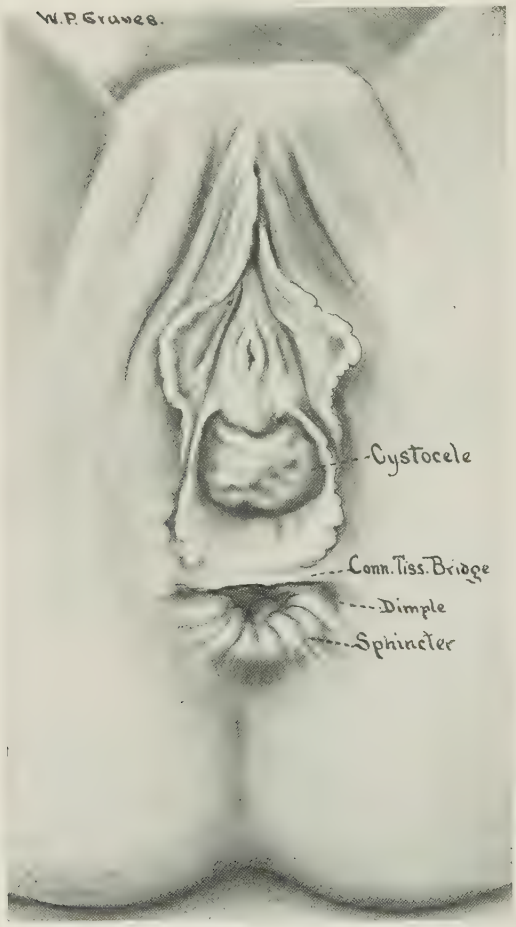


FIG. 224.—COMPLETE LACERATION OF THE PERINEUM, COMBINED WITH CYSTOCELE.

In this case a connective-tissue bridge has formed between the ends of the lacerated sphincter. The dimples, that indicate the position of the sphincter ends, are shown.

Many of the complaints frequently ascribed to lacerated perineum, such as backache, pelvic pressure, fatigue, are, in reality, due chiefly to the position of the uterus. It is remarkable how little discomfort patients may experience from extensive laceration of the perineum and rectocele if there is no descensus of the uterus or cystocele. Usually, however, the loss of perineal support increases the sense of weakness and pelvic pressure.

If rectocele is present, the patient is annoyed by the feeling of the protruding mass. Patients with rectocele often have difficulty in defecation.

Relaxation of the perineum frequently produces stasis of the circulation about the sphincter, causing hemorrhoids, which are usually relieved by repair of the perineum. If the laceration includes the sphincter muscle the result is fecal incontinence.

Laceration of the perineum is said to be one of the causes of sterility as a result of effluvium seminis, but this is somewhat doubtful.

The **diagnosis** of lacerated perineum is made by the touch and inspection. The amount of laceration is best judged by drawing the perineum sharply down-

ward and outward by inserting the two forefingers into the introitus. This reveals the extent of damage done to the lateral supports of the rectum.

If a complete laceration into the rectum is present, the bright-red mucous membrane of the gut can be seen rolling outward, just below the posterior entrance of the vagina. The ends of the torn sphincter are seen as well-marked dimples on each side of the anal orifice.

If the tear does not extend into the rectum, but only includes the fibers of the sphincter muscle, the anal orifice appears flattened and thin on the anterior or vaginal side. The characteristic dimples on each side of the orifice indicate clearly the position of the two ends of the lacerated muscle.

The **treatment** of lacerated perineum is usually only one step in connection with several other procedures in repairing the damage of childbirth. One rarely simply repairs a perineum, for, as has been said, it is nearly always associated with cystocele and descensus of the uterus. There are innumerable operations and modifications of operations for the repair of perineal relaxation. Some of the best of these are described in the section on Operative Surgery.

If the view of the pathologic anatomy of perineal laceration described above be accepted, the principles of the Emmet operation more nearly fulfil the logical requirements of repair than do any of the others. By the Emmet method the mucous membrane is denuded so as to expose the areas where the laceration took place. These areas we have seen are, first, the two lateral sulci, where the anterior fibers of the puborectales were torn from the sides of the rectal wall; and, second, the upper part of the central raphé, where the transversus perinei and the shoulders of the two sides of the levator ani met to form the perineal body. With these areas exposed, the sutures, when placed as shown in the description of the operation, artificially replace the ruptured fibers of the puborectales, and thus restore the lateral support of the rectum. The placing of these sutures in the two lateral sulci constitutes the first part of the operation. The second or external part of the operation consists in delivering into view the retracted masses of the levator ani and transversus perinei muscles and suturing them firmly together. When rectocele is present there is no operation comparable with that of Emmet for reconstructing the perineum. Most other operations are directed chiefly to the restoration of the muscular perineal body, but pay little attention to restoring the lateral support of the rectum. If there is little or no rectocele almost any one of the operations in common use is efficacious in securing a good result.

The operation for complete laceration of the perineum is simply an extension of the perineal operation, the denudation being carried down so as to expose the retracted ends of the torn sphincter. These ends are delivered into view and sutured together by the technic described on page 697.

## VESICAL FISTULA

Fistulous openings connecting the bladder with the genital tract are made most commonly during labor, as a result either of laceration of the tissues by

instrumentation or from prolonged pressure of the fetus, with consequent ischemia and necrosis of the bladder and vaginal walls. In the present days of improved obstetrics, and the frequent employment of Cesarean section when there is a disproportion between the size of the child and the capacity of the pelvis, vesical fistulæ from labor are far less common than formerly. On the other hand, fistulæ resulting from injury to the bladder during extensive pelvic operations are more common on account of the greater frequency with which such operations, especially those for uterine cancer, are being performed.

Cancer of the cervix and vagina is often complicated in the later stages by vesical fistulæ. They are sometimes caused by the curet in the course of a palliative operation for inoperable cancer.

In recent times the radium treatment of uterine and vaginal cancer is occasionally followed by fistulous openings in the vesicovaginal septum, which may be very extensive. Rarely malignant disease of the bladder and syphilis of the bladder or vagina result in fistula.

Fistulous communication between the bladder and intestines sometimes occurs as a complication of some destructive disease of the intestines, where the gut has become adherent to the bladder. Examples of this are cancer, tuberculosis, and diverticulitis of the intestine. Complicated fistulous tracts between the viscera are sometimes created through the medium of pus-tubes or infected ovarian cysts.

Vesical fistulæ are classified according to their position.

*Vesicovaginal* fistula, by far the most common type, implies an opening in the vesicovaginal septum.

*Vesicocervicovaginal* fistula relates to a communication between the bladder and vagina at the junction of the vagina and cervix. This is sometimes termed a *juxtacervical* fistula.

*Vesico-uterine* or *intracervical* fistula is the term applied when the opening is into the cervical canal, so that the urine has its exit through the internal os.

*Urethrovaginal* fistula is a communication between urethra and vagina.

*Enterovesical* fistula implies a direct or indirect opening between the bladder and intestines.

The size of fistulæ varies from that of a hair to the large cavernous openings such as are sometimes seen, where nearly the whole vesicovaginal septum has been destroyed.

Long-standing fistulæ are apt to be complicated by dense contracting adhesions which immobilize the parts and render plastic repair very difficult.

**Symptoms.**—The essential symptom of vesicogenital fistula is involuntary leakage of urine, which, if the opening is large, is continuous, whether the patient be upright or lying down. If the opening is small, or if folds of the vagina by chance act as a sort of valve, the leakage may occur only when the patient is upright. Such patients have partial or complete relief at night. When the fistula is very small the leakage, even in the upright position, may not be con-

tinuous, but may occur only when the bladder is comparatively full or after bodily exertion or expulsive acts, like coughing and sneezing. In such cases it is difficult to differentiate the condition from functional incontinence due to relaxation of the internal urethral sphincter.

Associated with the urinary incontinence of fistula there may be a cystitis, with inflammation of the vagina and irritating excoriation of the vulva and surrounding parts of the skin. In the majority of cases, however, there is surprisingly little inflammatory reaction either in bladder or vagina, the urine being normal and the epithelial covering of vagina and vulva showing little evidence of chemical irritation.

Patients with vesical fistulæ are continuously surrounded with a urinous atmosphere unless the most unremitting cleanliness is observed. To the self-respecting this odor is a source of distress and mental depression.

The **treatment** of fistulæ is entirely surgical, and involves a delicate operation for closure which is more or less complicated, according to the position of the opening. The details of the various operations are given in Part III.

The time to be chosen for operation is a matter of some importance. It is, as a rule, unwise to attempt the repair of a fistula at once, especially one which results from labor. The surgeon, if he has the chance, should wait until the complete involution of the tissues has been established, but not long enough for serious contractions to take place from the formation of scar-tissue. The tissues are usually most favorable for operation in about two or three months after labor. Most women with a fistula shrink from operation for a long time, so that the surgeon usually has no choice in the matter.

The **diagnosis** of the average case of fistula is simple, but when the opening is very small it is sometimes impossible to detect it by inspection in the folds of the vagina. The exact location should always be determined if possible before operation is attempted, in order to be sure that the case is not one of functional urinary incontinence. This can usually be done by injecting sterilized milk or methyelene-blue solution into the bladder and observing it as it leaks out into the vagina. In cases where there is leakage only when the patient is standing, methylene-blue solution is injected into the bladder and pledgets of cotton placed in the vagina. The patient is requested to walk about or make some physical exertion, when the pledgets of cotton are removed. That one which is in contact with the fistulous opening will indicate its location by the blue staining.

The diagnosis should always be confirmed by a cystoscopic examination, which also determines the relation of the fistula to the ureteral openings.

## ABDOMINAL HERNIA

Abdominal hernia is so much more common in women than in men and is so frequently induced by child-bearing that it must be included as a gynecologic disease. Hernial condition of the abdomen, aside from those hernias which involve the inguinal and femoral regions, may be divided into three classes: (1)

Diastasis of the recti muscles, (2) umbilical hernia, and (3) postoperative hernia of wounds.

Diastasis of the recti muscles is an extremely common affection and is nearly always the result of child-bearing. Occasionally it is the result of long-existing pelvic tumors which are large enough to distend the abdomen. In some cases it is caused by adiposity. Its presence depends, to a certain extent, on a pre-existing physiologic deficiency of tissue and constitutional muscular weakness, for it is sometimes seen to a very marked degree in women who have borne only one child, while other women who have had many children show no signs of it. Other things being equal, however, frequent child-bearing is a common etiologic factor. It is much more common among the poor and ill-nourished than among the well-to-do. This is doubtless due partly to diminished muscular tone and partly to the necessity of hard work during pregnancy and soon after delivery—work that is usually done with little or no artificial abdominal support. Diastasis of the recti is seen most commonly in the very thin and very fat, owing to the fact that in both types of women the abdominal muscles are diminished in supporting power. It is most frequently seen in women who show other evidences of the injuries of childbirth—*i. e.*, retroversion, prolapse, and relaxation of the vaginal outlet.

The separation of the muscles in diastasis is always most marked at the level of the umbilicus, and extends for varying distances both above and below this point, the extreme being a complete disunion of the two muscles from pubes to ensiform cartilage. The width of the separation varies from $1\frac{1}{2}$ to 4, 5, or even 6 inches.

In cases of simple diastasis there is no definite hernial ring. When abdominal pressure is exerted a longitudinal protrusion is seen in the center of the abdomen, always including the umbilical region. On each side of the hernial protrusion can be felt the edges of the recti muscles. The condition is often recognizable simply from inspection of the abdomen, especially if the patient is thin. It can be made evident by placing the hand on the abdomen and asking the patient to cough. A still better way to bring the protrusion into prominence is to ask the patient while lying on her back to raise herself to a semisitting position. In the effort to assume this position the recti muscles are brought into rigid contraction and the intestinal contents are forced out between them. When the patient is standing there is a characteristic sagging of the lower abdomen, especially if the patient is fat. In thin patients the contour is much like that of asthenic ptosis.

The clinical significance of diastasis of the recti muscles is much greater than is commonly recognized. To the gynecologist it represents one of the numerous injuries from childbirth, equal in importance to laceration of the perineum or displacement of the uterus. The symptoms of the condition are not always entirely definite. Together with other tissue relaxations from childbirth, it causes exhaustion after effort and general lassitude. Its most characteristic symptom in fat individuals is pain in the loins. This is due to

compensatory strain on the lateral muscles of the trunk on account of the deficient abdominal support. Dorsal backache is also very common. The digestive and neurotic symptoms that characterize asthenic ptosis are often seen in women with diastasis, in whom there exists a so-called acquired ptosis of the abdominal contents quite similar to that of the congenital type.

The **treatment** of diastasis of the recti muscles is either orthopedic or surgical. Orthopedic treatment consists in the application of an efficient abdominal support. This is best accomplished by a perfectly fitting corset.

A cure of the condition can only be gained by a surgical operation. In most cases this is feasible unless there is some constitutional contra-indication to surgery or unless the patient is too fat. In the enormously fat, where there is great abdominal tension, the operation is attended with more than average danger of postoperative complications. Most cases of diastasis are encountered in women who need general repair for the injuries of childbirth. There is emphasized in the discussion of these injuries (see above) the great importance of neglecting no single link in the chain of weakened structures, and in carrying out this plan the relaxed abdomen must be considered with the other lesions.

Inasmuch as in most of the cases of general relaxation the abdomen must be opened, opportunity is given to test the condition of the recti muscles. This is done after making the incision by grasping the abdominal wall in the direction of the umbilicus (see Fig. 478). by which the edges of the recti can easily be felt, and if they be separated the thin intervening membrane, composed of fascia and peritoneum, is made evident.

The operation, as performed by the author, consists in reduplicating the aponeurosis at the level of and above the umbilicus, so that the bellies of the recti muscles become contiguous. Below, the layers of the abdominal wall are approximated in the usual way. For a description of the operation, see page 821.

### UMBILICAL HERNIA

As stated above, umbilical hernia is far more common in women than in men because of the number of cases directly due to child-bearing.

It is not always possible to draw a distinct line between diastasis of the recti muscles and umbilical hernia. It must be emphasized primarily that in *all* cases of umbilical hernia there exists a greater or less degree of diastasis.

In typical umbilical hernia there is a distinct ring, with a well-defined hernial sac, while in diastasis there is a general protrusion in the space between the recti muscles without a specific ring or pouch. In large or recurrent umbilical hernias the two conditions sometimes merge.

In umbilical hernia there is a great tendency on the part of the intestines and omentum to become adherent to the ring and inner lining of the sac. In simple diastasis adhesions are usually absent.

On account of the adhesions and ring formation of umbilical hernia intestinal obstruction is always a threatening danger, which does not need to be regarded in simple diastasis.

The size of umbilical hernias varies from a small protrusion of the umbilicus to colossal sacs which contain most of the intestines.

The **symptoms** of umbilical hernia include those of the diastasis of the recti, which is always present. In addition are usually pains and abdominal discomfort due to the adhesions of the bowel and omentum. If incarceration or strangulation takes place, intense pain, vomiting, obstipation, and the various other symptoms of acute obstruction ensue. Umbilical hernias are not as liable to strangulation as are inguinal and postoperative hernias.

The smaller hernias are entirely obvious and easy of diagnosis, but the larger hernias, in which the protrusion of the umbilicus has become fused with the general sac, often cause confusion. These patients are usually fat and often present an immense abdominal enlargement, which frequently elicits the diagnosis of abdominal tumor, usually of ovarian cyst. Often these patients are credited with being much fatter than they really are, the hernial protrusion being regarded as a huge mass of fat, whereas, in reality, there may be very little fat between the skin of the abdomen and the intestines.

The **treatment** of umbilical hernia is surgical unless there is some constitutional contra-indication, or unless the chances of success are too small to warrant subjecting the patient to the risk of operation.

The operation for the large hernias, especially in very fat women, is, without doubt, a dangerous one. On account of the great size of the wound and the inevitable necrosis and dissolution of fat tissue, there is special danger of local sepsis. Pneumonia and embolism are other complications that are especially apt to occur. In addition to this must be taken into account also the possibility of a recurrence, which, if it does take place, usually results in a condition worse than that of the original hernia.

If the operation is inadvisable, the only course is the application of an abdominal support, the proper fitting of which requires great skill and experience. The best form of support is a perfectly fitting corset, but there are few who are able to fit a satisfactory corset to some of these very stout patients.

The surgical treatment for umbilical hernia is given on page 825, where the longitudinal and transverse types of operation are described.

The longitudinal operation has for its basis the approximation in the middle line of the separated recti muscles.

The principle of the transverse operation is the overlapping of the aponeurosis transversely.

The results of operations for umbilical hernia depend somewhat on the skill and ingenuity of the operator, but even with the best workmanship a certain percentage of recurrences is met with.

### POSTOPERATIVE HERNIA

In the present days of improved asepsis and operative technic postoperative hernias in abdominal wounds are comparatively uncommon, yet they still occur with sufficient frequency to be a matter of chagrin. Postoperative hernia is

usually the result either of incomplete closure of the wound or of wound sepsis, which in healing has left a point of weakness in the scar. By incomplete closure of the wound it is meant that there has been drainage, or that in sewing up the wound the surgeon has failed to secure perfect coaptation of the layers. Another class of cases, and a very important one, is that in which an incision has been made through an abdominal wall already weakened by a diastasis of the recti muscles.

Postoperative hernia usually makes its first appearance as a small protrusion under the skin, to one side of or above the cutaneous scar. It is slightly tender, and transmits an impulse when the patient coughs. If the hernia is not attended to, it grows gradually larger, finally involving the area about the wound and extending outward and upward over the abdomen. The hernia may consist of a single rounded mass, representing the protrusion of the bowel or omentum through a single ring; or it may be extremely irregular as the result of a complex hernial formation of numerous rings and sacs honeycombing the abdominal wall. The content of the hernial sacs, especially in the complex type, usually consists of omentum, one of the functions of which is to precede the bowel and to prevent its entrance through the breach in the abdominal wall. The protecting omentum nearly always becomes adherent to the ring and inner surface of the sac. It, however, may fail to block the entrance of the intestine, especially when the ring has been stretched to a considerable size, and the condition then becomes more serious.

The omental tissue contained within the hernial sac usually becomes hypertrophied, and this process, together with the formation of adhesions, prevents complete manual reduction of the hernia. It sometimes happens that the omental mass becomes strangulated and necrotic, in which case there can be felt in the abdominal wall a hard tender mass without symptoms of intestinal obstruction, but with constitutional evidence of toxic absorption. If a portion of the intestine is included in the sac it may become obstructed. Postoperative hernias are more dangerous than umbilical hernias as regards serious complications.

The **diagnosis** of postoperative hernia is usually simple, but not always. In one of the author's cases a mass in the abdomen lying beneath the scar, and diagnosed as a strangulated omental hernia, proved to be an implantation metastasis following an operation for adenocarcinoma of the uterine body. In another case the lump in the abdomen, diagnosed as postoperative hernia, turned out to be an adenomyoma growing from one of the round ligaments which at the previous operation had been crossed and sewed together in the middle line, according to Mayo's modification of Gilliam's operation.

**Treatment.**—Extreme care in closing abdominal wounds is one of the main duties of the surgeon, for on this depends chiefly the prevention of postoperative hernia. In operating for pelvic conditions that require drainage the gynecologist is particularly fortunate in being able to drain through the vagina, which not only is excellently adapted for the purpose by its position, but is also

practically exempt from the danger of hernia. Only in the most serious forms of pelvic suppuration is it necessary to drain through the abdominal wall. Thus, one of the most common causes of postoperative hernia of the earlier days is almost eliminated by improved methods of pelvic drainage.

In closing the wound after a pelvic operation the observance of a number of technical principles is valuable. It is an excellent plan just before sewing the peritoneum to reach into the upper part of the abdomen and pull the omentum down, spreading it like an apron over the bowels which lie just beneath the wound. If adhesions form along the inner scar they will be with the omentum and not the intestines. If a rupture occurs in the course of the scar, the omentum is by this means enabled to enter the breach first. It is not unlikely that the adhesions that sometimes form along the peritoneal side of the wound are themselves conducive to weakening the scar. In order to prevent this great care should be exercised not only in the matter of asepsis, but in avoiding trauma of the edges of the abdominal incision. Numerous methods are employed to insure this. Some use towels or gauze or sheet-rubber to protect the edges. There is some question whether these do not often do more harm than good. The best prophylactic is the *considerate handling of the tissues*, a rule that is applicable not only in this particular instance, but in the whole field of surgery.

In sewing the peritoneum care must be taken to secure a smooth perfect coaptation without gaps, especially at the ends of the incision.

The approximation of the bellies of the recti muscle is an important step in closing an abdominal wound and one that is too often regarded as unnecessary. The muscles are brought together by a few deeply placed catgut sutures tied only tight enough to secure approximation. Numerous good methods of sewing the fascia are in use, some of which secure an edge-to-edge union, while others employ the method of overlapping. As fascia tissue readily heals to fascia tissue any method which ensures a strong and perfect approximation of the fascial surfaces, *especially at the ends of the incision*, meets the requirements.

As has been stated, one of the causes for postoperative hernia is a previously existing diastasis of the recti muscles. It is very essential that this should be recognized and repaired during the course of the operation. This point, insufficiently recognized by abdominal surgeons, has been emphasized by Webster. The condition is especially to be sought for in operating on multiparous women and after the removal of large tumors.

The operation for postoperative hernia follows the technic of that employed for umbilical hernia, the basic principle of which is that the recti muscles must be approximated a considerable distance from the hernial ring in order to give adequate support to the new scar (see page 832).

Postoperative hernias following operations for hernias are discouraging catastrophes, for the recurrent hernia is usually far worse than the original one.

# Special Gynecologic Diseases

## ECTOPIC PREGNANCY

Ectopic pregnancy relates to those conditions in which the nidation and growth of the impregnated ovum take place elsewhere than in the uterine cavity. The ovum may become implanted in the tube, in the ovary, or on the peritoneum of the abdominal cavity. If the ovum develops in that part of the tubal canal which is included in the wall of the uterus the condition is termed an "interstitial pregnancy."

In by far the greater number of cases ectopic pregnancy takes place in the tube and usually in the outer half of the tube.

The ovum when expelled from the corpus luteum of the ovary is sheltered and guided to the tubal canal or oviduct by the fimbriæ, and is passively conducted to the uterus probably by the motion of the cilia that adorn the epithelium of the lining mucous membrane and by peristaltic movements of the tube wall. The passage of the ovum to the uterine canal occupies several days, possibly a week, and it is at the beginning of or during the journey that the ovum becomes impregnated by union with a spermatozoön. Under normal conditions the fertilized egg continues its course until it reaches the uterine cavity, where it embeds itself in the endometrium and proceeds to develop.

**Causes.**—Tubal implantation bespeaks some impediment to the ovum in its passage to the uterus. There are several causes for this interruption, some of which are sufficiently obvious. The frequency with which tubal pregnancy is found in tubes that have been damaged by inflammatory processes, such as result from gonorrhea and puerperal infection, is evidence that the interruption is the outcome either of destruction of the ciliated surface epithelium or of adhesions to the external surface of the tube which prevent its normal peristalsis. Thus, tubal pregnancy may result either from salpingitis or perisalpingitis. An acute appendicitis, the peritoneal infection of which extends to the tube and causes adhesions, may in the same manner be the indirect cause of a later tubal pregnancy.

The ovum may find its way into a diverticulum of the tube or into an accessory tube, and, becoming embedded there, develop an ectopic pregnancy.

The foregoing are anatomic causes which can often be incontestably demonstrated. Many times, however, this cannot be done, and the etiology then becomes a matter of speculation. Many theories have been advanced, some of them being worthy of note.

Sippel bases his theory of causation from observations that the ovum may enter the tube on the side opposite to the ovary from which it has been dis-

charged. This is exemplified in cases of right-sided tubal pregnancy with a corpus luteum verum of the left ovary, or when pregnancy has occurred after a pelvic operation, in which the tube from one side and the ovary from the other have been removed. Sippel assumes that the impregnated ovum during the time occupied by this long journey across the pelvis becomes too large to be moved along the tube to the uterus. It is assumed, also, that after a certain period the trophoblastic layer of the egg begins to exert its corroding influence on the maternal epithelium—the first step toward nidation. Under normal conditions this period is not reached until the egg arrives at the uterine canal, but it may well be imagined that the time taken to travel to the opposite tube may bring the ovum to the corroding point while still in the tube. It then sinks into the subepithelial tissue of the mucous membrane and its journey is at an end.

Freund has advanced the hypothesis that the conditions mentioned in Sippel's theory may result from the unusual length and convolutions of the tube, such as obtains in the infantile type.

Another theory for the etiology of extra-uterine pregnancy in normal tubes has been advanced by Katz. He has found that in pregnancy a definite change takes place in the mucous membrane of the tubes. The cylindric ciliated epithelial cells become markedly increased and heaped up on each other and lose their cilia. During menstruation the same process takes place, though in a less degree. Katz ascribes this change to the influence of the inner secretion of the corpus luteum. He thinks that this heaping up of the surface epithelium and the loss of the cilia, may act as a hindrance to the normal passage of the ovum through the duct. Thus he imagines that if an ovum were impregnated near the ovary it might have some difficulty in negotiating the route thus impeded and, becoming discouraged, settle down and develop in the folds of the mucous membrane of the tube. There may be some merit in this explanation, especially when one considers that most extra-uterine pregnancies take place in the outer half of the tube. It would seem at least reasonable to suppose that the abnormal impregnation might be due to an aberration of some normal physiologic function.

When a fertilized ovum becomes implanted in the tube it is destined to early destruction, usually within the first three months, although cases have been known where it has gone to complete development. The death of the embryo is due to the poor soil in which the egg has been inserted. The tissue of the wall of the tube is capable of only a small decidual reaction, so that the fetal tissue is improperly nourished. The wall of the tube, under the influence of the growth of the ovum and the general softening with which pregnancy affects all the pelvic organs, becomes thinner and softer and is easily ruptured.

Litzenberg in a recent monograph has shown by a series of longitudinal sections that no true basal decidua ever forms in a tubal pregnancy, and that even the so-called decidual reaction of the tubal stroma cells, though constant, is, in reality, exceedingly scanty. He lays emphasis on the importance of the basal decidua in protecting the uterine muscularis in a normal pregnancy from the eroding action of the trophoblast. In the latter case the blood-vessels of the thick uterine decidua are small, and only enough blood is appropriated by

the trophoblast to sustain the fetus. In tubal pregnancy, on the other hand, the tubal muscularis lacks the protection of a true decidua, and with its distended blood-vessels becomes an easy prey to the invading fetal tissue. The erosion of the large tubal vessels causes an effusion of blood far beyond the needs of the fetus. The intervillous spaces become crowded with blood and rupture takes place either through the internal or external capsule of the ovum.

Rupture of the surrounding capsule causes the death of the fetus and subjects the mother to grave danger. If the bleeding is free and unconfined the hemorrhage may be fatal in a short time, but if the bleeding is impeded the blood becomes coagulated and a hematocele forms. The latter process more commonly takes place.

Two pathologic forms are recognized as having special clinical manifestations—tubal rupture and tubal abortion.

Tubal rupture is applied to the condition in which the outer wall of the tube constituting the external capsule of the ovum ruptures and allows the maternal blood to flow unimpeded into the peritoneal cavity. This gives rise to the classical picture of sudden collapse and tragic death. Fortunately, tubal rupture is not nearly so common as tubal abortion. In tubal abortion[1] rupture takes place in the fetal capsule, but not in the wall of the tube itself. The blood, therefore, is confined by the tubal wall to a certain extent, and, being under restraint, flows less rapidly, time being given for clotting. In this way a hematoma is formed in the interior of the tube, and is termed a "tubal mole" or "hematosalpinx." The hemorrhage may be entirely confined to the tube, though the blood may in some cases flow freely from the ostium of the tube and cause collapse and death, as in tubal rupture. It more commonly trickles slowly into the peritoneal cavity, creating a large hematocele. Usually this hematocele is formed in the pouch of Douglas, where it can readily be felt by vaginal examination. At first it is soft and doughy, but in the course of time a semi-organized capsule forms around the mass, so that to the vaginal touch it is firm and well defined, often resembling an ovarian tumor.

If the posterior culdesac is obliterated by adhesions the blood-mass may accumulate in front of the uterus or higher up in the abdominal cavity.

The blood-mass which collects outside of the tube is termed a "pelvic hematocele." The leaking of blood from the tube may continue over a considerable period of time, so that an enormous hematocele may form, filling the pelvis and the lower part of the abdominal cavity.

[1] Litzenberg objects to the term "tubal abortion" which should be applicable only in cases where there is an actual separation of the ovum, a circumstance which in his opinion is exceedingly rare. Instead of tubal abortion and tubal rupture he substitutes "internal" and "external" rupture. Internal rupture denotes a break through the inner ovum capsule into the tube lumen. External rupture, he states, "may be either a true bursting of the weakened arroded tube wall under pressure from within, due to the growth of the ovum, or distention by hemorrhage, or it may be only an arrosion by villi, the wound being very small, and yet it may terminate fatally because a large vessel has been opened."

These hematoceles present an excellent medium for the growth of bacteria, and if they become infected, sometimes develop most extensive and destructive abscesses.

The most marked instances of infection are seen in women who, thinking themselves normally pregnant, attempt abortion.

Infection of tubal or pelvic hematoceles may also result from vaginal puncture under the mistaken diagnosis of pus-tubes.

After rupture the embryo and all the fetal tissue are rapidly absorbed. Nothing is seen of them in the majority of specimens removed by operation. On account of this disappearance of fetal tissue the question is sometimes raised whether a small hematosalpinx is the result of bleeding from ectopic gestation or from some other cause. Doubtless in rare instances a hematoma may be formed in the tube by inflammatory processes. It is so unusual, however, that a hematosalpinx is ordinarily assumed to be the result of a tubal abortion, Veit asserts that patency of the tubal ostium is evidence of ectopic pregnancy, while if it is sealed the bleeding is probably from inflammatory ulceration. It is very doubtful if this is a reliable test.

The development of a tubal pregnancy produces a decidual reaction in the endometrium of the uterus similar to that following a normal pregnancy.

At the time of rupture of the tubal sac bleeding from the endometrium takes place, continuing until the termination of the tubal pregnancy. This decidua desquamates away from the uterine wall, and appears as shreds of formed tissue in the vaginal discharge; sometimes it comes away as a complete cast of the uterine canal.[1]

It has long been a matter of doubt whether the uterine bleeding associated with ectopic pregnancy is a part of the tubal hemorrhage flowing backward through the uterine ends of the tubes, or whether it issues from both sources. The recent work of Sampson seems to have definitely settled this point. By means of injecting uteri, removed for tubal pregnancy, he has shown that the uterine bleeding in all cases is venous in origin and arises from the endometrium, and that in no case does it escape from the tube into the uterine cavity.

In all cases of ectopic pregnancy the uterus is increased to the size that it attains under the influences of normal pregnancy at about two months. Sampson has shown that this enlargement is due to the thickening of the endometrium and the hyperemia of the organ, there being much doubt as to any increase in the musculature. The bleeding results from the venous congestion in the endometrium. The enlargement of the uterus and the bleeding continue until the abortion of the tube is complete, when involution takes place, as it does

[1] Ectopic decidua has been observed on and in the ovary, on the peritoneum of the uterus (mostly its posterior surface), on the pelvic peritoneum (especially in Douglas' pouch), more rarely on the parietal pelvic peritoneum, on the anterior wall of the uterus, the vesico-uterine space, on the ligaments of the uterus, on the omentum, the small intestine, the vermiform appendix, on the mucous membrane of the tube even in intra-uterine pregnancy, in the cervix and vagina, in polyps, adenometritic foci, proliferating scars, and on adhesive bands, and very rarely on the peritoneum of the tube. According to Meyer, it is not a physiologic condition. The chief factor in its causation is probably a preceding inflammation. (Moraller, abstract from R. Meyer.)

after complete abortion of uterine pregnancy. The separation of the decidua is the result during the subinvolution period of venous extravasation of blood between the inner and outer layers of the endometrium by which the outer compact layer is expelled.

**Symptoms.**—There are, as a rule, no subjective symptoms in ectopic pregnancy until there is rupture of the surrounding envelope. The patient usually passes her regular time of menstruation and often considers herself pregnant. In the typical case the first symptom is a sharp lancinating pain in the side, which may be so severe as to cause the patient to fall. Pallor, small rapid pulse, and air-hunger follow, and, if the rupture is through the outer capsule into the abdominal cavity, or if there is abundant hemorrhage from the ostium of the

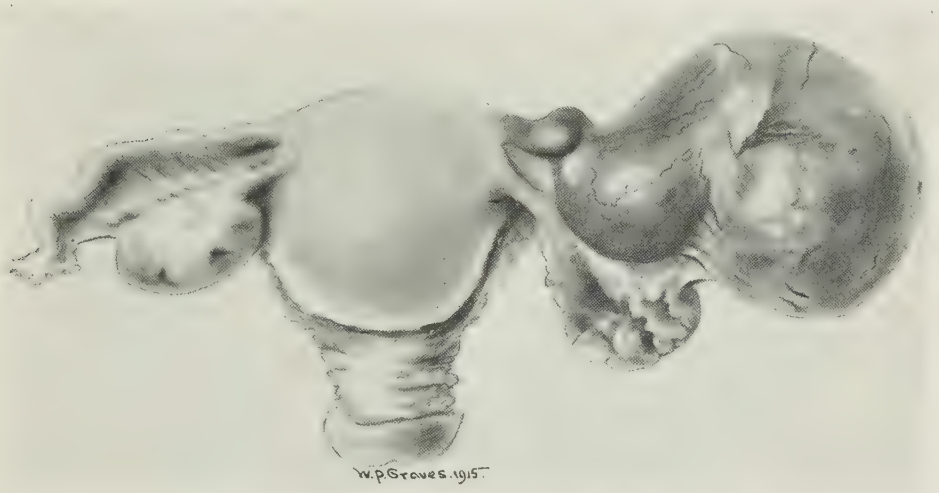


FIG. 225.—TUBAL PREGNANCY. HEMATOSALPINX.

The dark-colored tube distended with blood-clot is seen. There are adhesions on the surface. The ovary has been included in the adhesions and lacerated in its removal. For purposes of clearer illustration the uterus and other adnexa have been added in the drawing.

tube, the patient may bleed to death in a short time. Catastrophies of this kind are, however, comparatively uncommon. In the majority of cases the patient survives the first attack, which may be so mild as to cause little apprehsnsion. Patients often describe the attack afterward as a fainting spell. If the first hemorrhage is survived the patient continues to have repeated twinges of pain, usually of a sharp, lancinating character. Very soon after the first symptom of pain the uterine bleeding appears. This is rarely profuse. In the course of time shreds of decidua are discharged, described by the patient as fleshy material, while sometimes the decidua is expelled entire in the form of a cast of the uterine canal. When the symptoms pursue this course, the case is to be regarded as one of tubal abortion, in which the initial active hemorrhage was sufficiently delayed by the pressure of the tubal capsule to cause clotting. Examination

of a patient with tubal abortion discloses a pelvic mass. If the bleeding is confined to the tube it can at first be felt as a sausage-shaped tumor, extending at right angles to the uterus. If the tubal mole becomes large and heavy it sinks into the posterior culdesac, where it can be felt as a rounded, well-defined mass, pushing the uterus forward toward the pubes. If there is gradual bleeding into the peritoneal cavity a hematocele forms, usually in the posterior culdesac, which at first is felt per vaginam as a soft doughy mass, and if successive examinations are made its increase in size may be recognized.

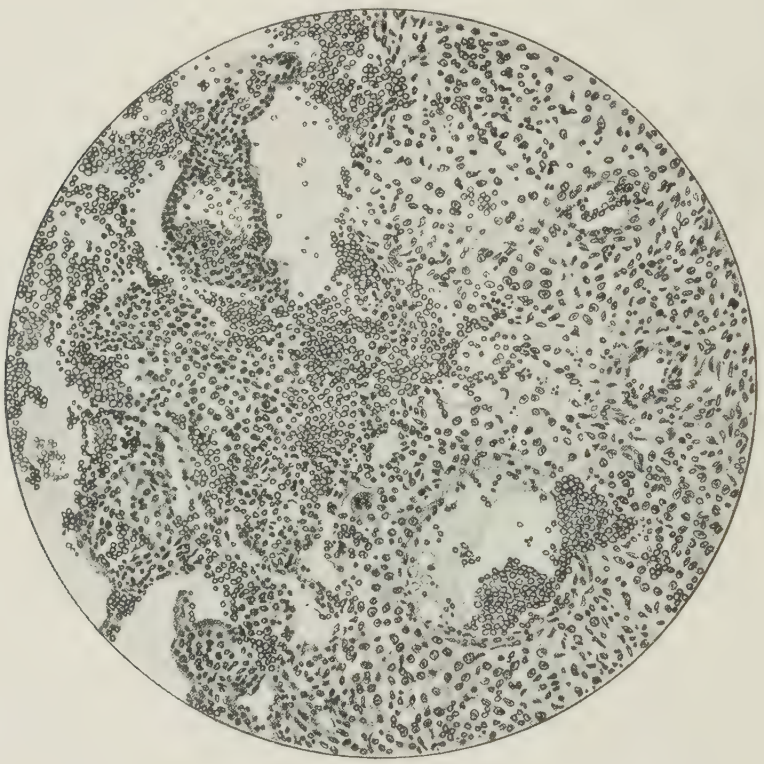

FIG. 226.—DECIDUA IN TUBE.

Low power. In the upper right part of the drawing can be seen the swollen stroma cells of a villus of the tube which have taken on the characteristics of decidua cells. In the upper left is a chorionic villus. In the lower right is a blood-vessel. Blood-corpuscles are seen lying in the tissue. (From a case of tubal pregnancy.)

If the hematocele remains for a long time in the cavity without absorption a semi-organized capsule forms about it, which gives the examining finger the sensation of a cyst or soft myoma. The hematocele may become so large as to be easily felt through the abdomen, sometimes extending to the level of the umbilicus.

Tubal abortions, even when the hematocele is of large size, sometimes heal spontaneously by absorption of the blood-clot. This process is occasionally astonishingly rapid. More often the symptoms continue for several weeks

until surgical aid is sought. During this period the patient continues to have frequent pain and irregular uterine bleeding. The protein decomposition of the clotted blood often, though not always, produces a form of auto-intoxication, which may be of a serious character. Patients with absorbing hematoceles are apt to run a moderate elevation of temperature and suffer from various intestinal disturbances. Sometimes they acquire a peculiar greenish, waxy pallor

Fig. 227.—Decidual Cast.

Low power. The stroma cells of the endometrium become enlarged, most of the enlargement being in the protoplasmic part of the cell, and they become flattened instead of round and oval, due to pressure against each other. The intercellular connective tissue disappears. The epithelium of the glands is lost or consists of a single layer of low inactive cells. There is a slight infiltration with leukocytes. Decidual casts are found in extra-uterine pregnancy.

of the facies and occasionally exhibit mental aberrations. A moderate leukocytosis is usually present.

If the hematocele becomes infected, symptoms of acute pelvic inflammatory disease ensue, usually of a very serious nature.

**Diagnosis.**—One seldom sees an extra-uterine pregnancy in the first stage before rupture. In this stage the tube is soft and not easily palpable. The delay of menses and the enlargement of the uterus make an exact differentiation from a normal pregnancy very difficult.

In the second stage, or that of rupture, the cases of severe bleeding are very

characteristic and easily recognizable. The sudden terrific abdominal pain and the tragic collapse of a woman in full health is unmistakable.

A similar clinical picture is seen in the rare instances of ruptured Graafian follicle with hemorrhage into the pelvic cavity. (See Blood Cysts of Ovary.)

In the chronic stage the diagnosis is often confused and difficult to make. The history is of the greatest importance, the chief factors of which are the age and social condition of the patient, the question of delayed menses, the character and location of the initial and succeeding pains, and the time and nature of uterine bleeding.

Most patients with ectopic pregnancy give a history of passed or delayed menses, but occasionally cases are seen in which there has been no appreciable irregularity, and when this happens the diagnosis is especially misleading. The nature of the pain in ectopic cases is usually rather characteristic. It is felt in one side of the pelvis, and is peculiarly sharp and lancinating and often accompanied by fainting spells. In contradistinction to this the pain of an abortion is less sharp and usually referred to the uterine region, while the pain of pelvic inflammation is dull and more constant. It is often very hard to distinguish between a tubal abortion and a threatened or incompleted uterine abortion. In both cases history of delayed menses, pain, and onset of bleeding correspond to either condition. The pelvic examination may also be equivocal, for the uterus is enlarged and soft in both conditions, while a large corpus luteum or cystic ovary of a normal pregnancy may present to the examining finger a feeling no different from that of a small tubal sac of an ectopic pregnancy.

Microscopic examination of curetings give some information, for if chorionic villi are present ectopic may be ruled out. Sometimes, however, the fetal remains of a uterine abortion disappear rapidly, while the decidual reaction may be seen for a considerable time. Under these conditions the microscopic examination would be of no value.

An interstitial pregnancy is essentially ectopic, and its symptoms and course are practically the same as those of tubal pregnancy. The diagnosis by bimanual examination is very difficult and requires a most expert touch; when there is doubt, examination under ether should be urged.

Sometimes a normal pregnancy at two or three months, in which there is some asymmetry of the uterus, may simulate closely an extra-uterine pregnancy at first examination. Under anesthesia the doubt is usually expelled at once.

On account of the ease by which errors can be made in the diagnosis between extra-uterine and normal pregnancy it is important *always to make a preliminary vaginal examination under ether before performing an abdominal operation for ectopic pregnancy.* If this is made a routine procedure, unnecessary surgery will not infrequently be avoided.

The expulsion of decidual shreds or a uterine cast is very useful evidence in

cases of suspected ectopic pregnancy, but even this may be misleading, especially in women who have a history of exfoliative dysmenorrhea.

The doughy, irregular feel of a soft pelvic hematocele is quite recognizable, especially if the uterus can be well defined as being pressed forward in anteposition. If the hematocele acquires a semi-organized capsule the mass becomes smoother and firmer to the touch and may be quite deceptive. Such a tumor may simulate closely an ovarian cyst, a soft myoma, or a pus-tube. It may, if symmetrically placed in the posterior culdesac, feel exactly like a retroflexed fundus of a pregnant uterus.

The differential diagnosis between a long-standing tubal abortion and pelvic inflammation is sometimes very baffling.

The tubal mass, the intermitting pain, and the irregularity of the menses may sometimes apply to either condition, and a mistaken diagnosis is often made. Little harm is done, however, by the mistake, as an operation is usually indicated in both cases.

As a rule, extra-uterine pregnancy is unaccompanied by temperature, but if there is a disintegrating hematocele a moderate fever may be present. Marked elevation of temperature would indicate an inflammatory process.

**Treatment.**—If an ectopic pregnancy is discovered in the first stage—*i. e.*, before rupture—immediate removal of the tube is indicated.

In case of tubal rupture, with sudden collapse and alarming symptoms, it is undoubtedly best to operate immediately if proper surgical facilities are at hand. The operation can be done very rapidly, with little additional shock to the patient. From the observation that patients often survive the first attack it was at one time the custom of many surgeons to wait for this possible outcome before attempting operation. In hospital practice, at the present time, expectant treatment is not to be advised, for in this way some patients will be lost who might have been saved by prompt intervention. The modern simplified methods of blood transfusion constitute a valuable life-saving measure in these cases when used in connection with a surgical operation.

In the third stage of tubal pregnancy, namely, that of regression of the hematocele after tubal abortion, surgical intervention is not as urgent, and time may usually be taken for establishing a correct diagnosis. When a diagnosis is made of probable aborted extra-uterine pregnancy the question of operation or expectant treatment arises. It is known that many cases get entirely well spontaneously and even have later normal pregnancies. Is it best, therefore, to keep the patient under observation and wait for this possible outcome? Unless the hematocele is far advanced in its process of absorption and other signs point to an early spontaneous cure the expectant treatment is not to be advised. It sometimes happens that a secondary rupture occurs which may be fatal to the patient, and this may take place at any time during the so-called termination period. This catastrophe is not very common, yet it occurs sufficiently frequently to act as a menace. It is difficult at any one time to tell whether the

oozing and accumulation of the hematocele has ceased. Even if imminent danger has passed, most patients with hematoceles are destined to weeks and months of invalidism before a complete absorption of the blood can be accomplished. During this time there is risk of infection, formation of pelvic adhesions, and the toxic effects of the absorbing blood-clot. It is better to operate, remove such organs as are necessary, and completely empty the abdominal cavity of blood.

It may be said, therefore, in general, that ectopic pregnancy in all three stages is very definitely a surgical disease, and that usually prompt intervention is indicated.

The technic of operating is a matter of considerable moment and of some difference of opinion. Unquestionably, the abdominal route is the most advantageous in all stages of the disease. Among other reasons for using the abdominal route is the importance of removing the blood completely from the abdominal cavity, a procedure that cannot be as thoroughly accomplished per vaginam. It was at one time thought that the absorption of blood from the peritoneal cavity was in some way useful to the patient, and some surgeons went so far as to leave as much blood as possible in the abdomen. The error of this has already been pointed out, and it is necessary to remove all the blood possible unless the patient is in such extreme condition that the time and manipulation required for sponging out the blood would be dangerous to life.

In operating for ectopic pregnancy judgment as to what tissues to remove is a matter of moment. If only the offending tube is removed, it must be remembered that the same process that caused the abnormal nidation of the ovum may act again in the opposite tube. The figures of Richard R. Smith, who has collected valuable statistics on this subject, show that only about 33 per cent. have normal uterine pregnancies later, while about 15 per cent. have a repeated ectopic pregnancy. The question, therefore, of preserving or removing the other tube is often an important one. This must be answered, as in other questions of conservatism or radicalism in pelvic surgery, on the ground of the age of the patient, her desire for children, and sentimental considerations as to the loss of genital organs.

The decision of removal or preservation of the uterus must be based on the same grounds as those in the treatment of pelvic inflammatory disease (*q. v.*).

## DYSMENORRHEA

The word *dysmenorrhea* is used in two somewhat different senses. In one sense it is simply descriptive of the symptom pain occurring at menstruation; in the other it is the name of an actual disease. When it is used to denote a disease it is best to employ the term *essential* dysmenorrhea, suggested by Schaeffer.

## ESSENTIAL DYSMENORRHEA

Essential dysmenorrhea is a disturbance that is characterized at the time of menstruation by severe cramp-like pains of the lower abdomen, from which the patient is entirely free during the intermenstrual period. This form of dysmenorrhea is very distinctive, and must not be confused with the kind of menstrual pain which represents an aggravation during the menstrual congestion of the more or less continued pain from various pelvic disorders, like salpingitis, pelvic inflammation, appendicitis, chocolate cysts, etc. This latter form of dysmenorrhea might more exactly be termed "secondary" or "acquired dysmenorrhea."

Essential dysmenorrhea, though one of the commonest of gynecologic diseases, is one about which little is known.

**Etiology.**—A satisfactory interpretation of the etiology of true dysmenorrhea has not yet been made, but the various theories are interesting and are of some practical value. The older authors regarded the cause of dysmenorrhea as due entirely to mechanical obstruction. Others divided the disease into three classes—an organic form, depending on obstruction, a congestive, and a neuralgic form. Others divided dysmenorrhea into uterine and ovarian varieties.

The theory of mechanical obstruction is based on the idea that the flow of blood is interfered with by a congenital stenosis of the internal os, so that, being dammed back in the uterine cavity, it becomes clotted and acts as a foreign body, setting up contractions of the uterine body. The cramp-like pains are caused by the passage of the clotted blood as it is forced through the internal os.

This stenosis may be due to a misplacement, of which anteflexion is the more common and retroflexion the less common type. Inasmuch as these two forms of uterine flexion are due to deficient development, dysmenorrhea has long been regarded as the result of genital hypoplasia.

In the obstructive theory the swelling of the endometrium, whether it be the premenstrual edema or a true, permanent, pathologic hypertrophy, plays a considerable part, as it is supposed to increase the obstructive narrowing of the internal os. Gebhard describes an endometritis dysmenorrhoica, in which the mucosa is greatly thickened at the time of menstruation and filled with fine particles of clotted exudate. He thinks that this exudate exerts a pressure on the uterine nerves which is expressed by dysmenorrheic pain.

It should be said in passing that these views regarding endometritis and clotting of the blood do not harmonize with the more recent ideas of hypertrophic endometrium as a phase of a physiologic menstrual cycle, and of the clotting of the blood as a result of the abnormal chemical influence of the ovarian inner secretion. Moreover, the hypertrophied endometrium does not seem to be as constant an accompaniment of anteflexion and retroflexion as the older writers supposed.

Theilhaber denies that the misplacement of the uterus, or stenosis of the

internal os, or hypertrophy of the endometrium have anything to do with dysmenorrhea as etiologic factors, but sees the cause in a spastic contraction of the circular muscular fibers around the internal os, called forth by a predisposition to abnormal nervous irritability.

Menge refers the trouble to the physiologic menstrual contraction waves of the uterus, which in women who are bodily and mentally sound are unnoticed, but which in women who have lesions of the genital organs, or who are of a neurotic constitution, are felt as labor-pains. In other words, Menge regards the disease as a psychoneurosis.

Krönig, though admitting the possibility of mechanical causes, considers most dysmenorrheas as psychoneuroses.

An interesting theory is proposed by Victor Schultz, who starts with the fact that the transformation of the infantile uterus into mature development is gradual and often delayed. During this change the connective tissue in the outer layer of the uterine wall, which is in excess in the infantile organ, gives way normally to muscle tissue. If this change is delayed or does not take place, the uterine contractions at the menstrual period cause a "stretching pain" in the insufficient uterine wall. This theory is thought by Schultz to account for the fact that dysmenorrhea is so often seen in persons with hypoplastic genital organs. The spontaneous cure often seen after childbirth he considers as due to structural changes in the uterine wall.

Stolper considers that dysmenorrheic pains are due to uterine contractions in the presence of congested circulation. He thinks that the real cause of the trouble lies in the abnormal venous congestion of the uterus that might result from sexual or bodily overexertion, constipation, sedentary life, onanism, etc.

Olshausen describes an ovarian dysmenorrhea which is independent of any form of pelvic inflammatory process, and which he regards in the light of an ovarian neuralgia.

A so-called "nasal dysmenorrhea" has been described by Fliess and elaborated by Schaeffer. It is shown that in some cases the pains of a dysmenorrhea may be cured by the application of cocain to the tuberculum septi, which is designated the "genital spot."

With this array of conflicting theories, the problem of etiology seems far from a solution. Leaving theory aside, there are certain facts which occur with sufficient constancy to give some basis for working out a method of treatment.

There is no question that a malposition of the uterus occurs so frequently with symptoms of dysmenorrhea that there must be some etiologic relationship between the two conditions. This idea is substantiated by the fact that many cases of dysmenorrhea are completely cured by correcting the malposition.

The most common malposition seen in dysmenorrhea cases is anteflexion, while developmental retroflexion is not infrequently met with. If a large number of anteflexion cases are studied it will be found that in the great majority of them the uterus, besides being anteflexed, is *retrocessed*, or sagging back

toward the sacro-iliac fossa. When the abdomen is opened and such a uterus is brought up toward the abdominal wound, it will be found that the organ is lax, and that the angulation is due not to an anterior spastic contraction, but to a sagging back or a squatting down due to relaxation. The condition is, therefore, actually one of retroposition, and differs only from retroversion in that the fundus is kept pointing in a forward direction, either by the round ligaments or by the structure of the musculature. The cervix in anteflexion cases lies in the same position relative to the vagina as it does when the uterus is retroflexed. All plastic operations on the cervix, therefore, do not in any way alter the essential position of the uterus relative to its normal level in the pelvis.

Another anatomic condition frequently but not always present in these cases is a distinct cicatricial band at the internal os, which can be distinctly felt while dilating the cervix, and which often makes the dilatation of the internal os difficult. As to the canal itself, an actual obstructing stenosis is never demonstrable in these cases.

Hypertrophy of the endometrium is by no means constant. In our experience it has not appeared more frequently than in parous women without dysmenorrhea. It is more common in the retroflexion than in the anteflexion cases.

Most of the cases show a moderate degree of hypoplasia, as indicated usually by a long conical cervix. When, however, the uterus and adnexa are seen within the abdomen and the uterus brought up into position, the condition of hypoplasia often is not noticeable.

We find, therefore, in most cases of true dysmenorrhea certain anatomic changes, which occur with sufficient regularity to assign a definite relationship between them and the menstrual pain:

(1) Malposition of the uterus nearly always present; usually a retrocession with anteflexion; less commonly a retroflexion; occasionally anteflexion without retrocession.

(2) Moderate hypoplasia, chiefly apparent in the form of the cervix, nearly always present.

(3) Cicatricial band at the internal os, not constant.

(4) Hypertrophy of the endometrium, not constant.

The important factors are malposition and hypoplasia of the uterus. We have seen that the malposition of the uterus is usually due to a relaxation and sagging of the uterus on itself, rather than to a spastic contraction of the uterine muscles. The condition is frequently seen in conjunction with ptosis of the kidney or of the colon, so that fundamentally it would seem as if the lesion were due to a physiologic deficiency in the supporting tissues. The so-called "congenital" misplacements of the uterus probably occur at the time of puberty, when the organ takes on a very rapid development, and it is conceivable that a uterus which develops in an improper position may be retarded in its full growth by partial interference with its blood-supply. This would account for the moderate hypoplasia that is usually present, and, in this sense, the hypoplasia

might be regarded as secondary to malposition of the organ. This would also explain the fact that the condition is frequently seen in women who are in every other respect fully developed.

We have shown in the enumeration of the various theories as to the etiology of dysmenorrhea that by some the symptoms are regarded purely as a manifestation of a psychoneurosis. It must be admitted that these patients are usually very nervous and often extremely neurotic. The question is raised, therefore, Which is primary, the dysmenorrhea or the neurotic condition? Vedeler, Krönig, and others believe the neurosis to be primary. We have here the same problem that is discussed under the title of Postoperative Psychoneuroses, in which it is attempted to show that the nervous condition is secondary and due to constant nagging pain and discomfort. In dysmenorrhea the pain is periodic, to be sure, and is completely absent during the intervening period. Nevertheless, the pain is so severe that in time patients become nervously exhausted during the menstruum. The effect of this lasts longer and longer into the intermenstrual period, until there comes a time when the patient hardly recovers from one period before the next one is upon her, and in this way the nervous irritant is constantly maintained. The pathologic mental habit then becomes fixed and the patient develops into a confirmed neurotic. This course of symptoms may frequently be followed in the history given by mothers of school girls who are brought for consultation, in many of whom the increase of nervous symptoms is the chief cause for seeking medical advice. There is no doubt that when this condition of pathologic mental habit is reached there is much "overvaluation" and exaggeration of symptoms, and that such patients may be greatly relieved by suggestion and mental therapy.

**Symptoms.**—The patient with essential dysmenorrhea usually feels perfectly well between her periods, as far as any local condition is concerned. At the menstrual period, however, either just before or at the time of the appearance of blood, the patient is seized with severe, often agonizing, cramp-like pains in the lower abdomen, which extend into the back or down the legs, lasting with a few intermissions from a few hours to one or two days. During this time the patient is more or less incapacitated from normal activities and is usually confined to bed. Severe headache and general malaise are often present, while vomiting is not uncommon. The disease usually appears early in menstrual life, often at the first menstrual period, and gradually increases in severity. It is frequently relieved by married life, but is sometimes aggravated by it. Patients with essential dysmenorrhea are very apt to be sterile, the two conditions evidently being referable to the same causal factor. If, however, pregnancy and childbirth take place the dysmenorrhea is often cured.

The **treatment** of dysmenorrhea is difficult and unsatisfactory. The methods of treatment, both medical and surgical, are exceedingly numerous. All the methods used are sometimes successful, but all of them fail frequently. Medical treatment is less satisfactory than surgical. Some of the drugs used are hy-

drastis, cottonroot, viburnum, aspirin, antipyrin, acetanilid compounds, pulsatilla, hyoscyamus, dionin, salipyrin, salcodein, bromids, ovarian extract,[1] atropin, morphin, cocain, alcohol, and many others.

Litzenberg has recommended benzyl-benzoate. We have found this drug useful especially in the form of esterol. We are accustomed to use it in association with ovarian residue, the latter being given in 5-grain doses, three times daily for ten days preceding the period. At the onset of pain the residue is discontinued and esterol given for two or three doses at three-hour intervals.

Among the numerous drugs used for dysmenorrhea, atropin is at present receiving much attention. It has been employed with much success by Drenkhaber, who injects the drug directly into the cervical canal. The dose is 1 mg. in 1 c.cm. of water. Many writers report good results by oral administration. The drug is administered two days before menstruation is expected to appear and continued until the second or third day of menstruation, depending on the duration of pain. The average dose is $\frac{1}{100}$ grain three times daily. E. Novak recommends giving aspirin in combination with the atropin in some cases.

In cases in which atropin does not prove effective Spitzig recommends the use of sodium citrate, 20 grains three times a day, during the week or two preceding the expected period. The administration of citric salts is supposed to diminish the viscidity of the uterine blood that is produced by the menstrual congestion.

Klein divides dysmenorrhea into two types, one in which there is hyperactivity of the ovarian secretions and one in which the function is defective. In the first case there is excessive edema of the uterine mucosa. He regards the uterine colic under these conditions as caused by the swelling of the mucous membrane. In the second type of dysmenorrhea there is atrophy of the mucous membrane and a flabby undeveloped musculature of the uterus. In this type Klein thinks that the uterus is unable to expel the blood properly, so that it stagnates, becomes clotted, and thus causes pain when finally expelled. On the theory that the ovarian and adrenal secretions are antagonistic Klein recommends the use of adrenalin in cases of dysmenorrhea due to oversecretion of the ovary and reports only two failures in the treatment of 35 patients. In the second type of case where the ovarian secretion is deficient he recommends giving pituitrin with the adrenalin, on the ground that it causes contractions of the uterus and thus promotes early discharge of the blood before it becomes clotted.

The nasal treatment of dysmenorrhea, first suggested by Fliess in 1897, has received considerable stimulus of late years from the work of Brettauer and Mayer, who have reported numerous successful results in properly selected cases. According to their reports, immediate relief is almost invariably accorded to those who have abnormalities of the nose, such as deflected septa, hypertrophy of the middle turbinates, enchondroses of the septum, etc. In this class also are included those cases which, without anatomic stenoses, exhibit tumefaction and engorgement of the mucous membrane about the "genital spots" at the time of menstruation. The treatment is especially successful in the type of dysmenorrhea that is characterized by premenstrual headache, nausea, and colic at the onset of the flow.

Brettauer and Mayer have given up the use of cocain, as originally recommended by Fliess, and in their later work have used the galvanocautery or tri-

[1] The author has recently had striking success in a number of dysmenorrhea cases with a preparation of desiccated ovaries of pregnant animals minus the corpus luteum. The most marked effect of this extract is seen in its influence on the headache, nausea, and vomiting from which many dysmenorrheic patients suffer. See also section on Ovarian Organotherapy.

chloracetic acid, chiefly the latter, the results of which they find more lasting than those after the use of cocain alone. Their present technic is to make four applications of trichloracetic acid between the periods, and if beneficial results follow, to repeat the same treatment during the next intermenstrual period. By this method they obtain permanent relief in from 50 to 75 per cent. of cases.

The operative and orthopedic treatment of dysmenorrhea is based on the assumption that the principal etiologic factor is a mechanical one and lies in the improper anatomic position of the womb. The following are some of the operative measures used:

The operation of dilatation and curetment has been used from the time of Marion Sims, the original idea being to correct the stenosis of the internal os and to straighten out the angulation of the cervix. The curetment was for the purpose of removing the supposedly inflamed mucous membrane, which by its swelling was thought to aid in obstructing the uterine canal. This operation frequently effects relief and even complete cure of dysmenorrhea. Almost as frequently it does no good at all. No satisfactory explanation of either the positive or negative results of this operation can be given, but it may be said that it is successful sufficiently often to warrant its routine use either by itself or in connection with other more elaborate surgical procedures.

In our own series of cases, in which we have been able to obtain definite reports at least a year after the operation, 60 per cent. of the dysmenorrhea patients were relieved or cured by simple dilatation and curetment. The other 40 per cent. were either not relieved at all or only temporarily so.

A second type of surgical treatment for anteflexion-dysmenorrhea is represented by various plastic operations on the cervix designed to straighten out the canal. The most commonly used of these operations is the posterior discission of the cervix. The technic employed in this country is that of Dudley, which is described on page 742. Many excellent results have been reported from this method, both as to relieving dysmenorrhea and sterility. The objection to the operation is that it mutilates the cervix and leaves a condition of artificial laceration which sometimes has to be repaired in order to relieve symptoms. By this operation the cervix is slit open as far as the internal os, so that the cervical canal is entirely eliminated, and the uterine canal opens into the vagina directly from the internal os.

Another similar operation is that proposed by Pozzi (see page 741), which consists of dividing the cervix bilaterally up to the internal os and approximating the edges of the wound in such a way that a permanent, deep, bilateral artificial laceration is effected. This operation is open to the same objection as that of Dudley. It is apt to be followed by a troublesome endocervicitis.

Still another operation on the cervix is one used many years ago by Pfannenstiel and later revived by W. H. Baker. It consists in the removal of a trans-

verse wedge from the posterior lip of the cervix as high up toward the vault of the vagina as possible. After sewing up the wound made by the removal of the wedge, the angulation of the cervix is straightened out and the parts are left in a normal unmutilated condition. This operation is sometimes, but not always, successful.

In operations of this type the cervical canal is always dilated as a routine measure.

The orthopedic treatment of dysmenorrhea in anteflexion cases is the use of a uterine stem-pessary, inserted after dilatation and curetment under ether, and left in for two or three menstrual periods, according to the method suggested by Davenport. This method of treatment is often very effective. The objection to it, however, is that it violates the laws of antisepsis, and leaves in the uterine canal a foreign body which cannot be kept clean.

A third and more satisfactory type of operation for dysmenorrhea, including cases of both ante- and retroflexion, is, in addition to the dilatation of cervix, the performance of an abdominal operation, with a proper suspension of the uterus so as to straighten out the angulation. This method of treating anteflexion is a result of observations that the uterus when anteflexed is usually in a condition of relaxation, being retrocessed toward the sacrum and doubled on itself. By drawing the uterus forward and facing it slightly toward the abdominal wall the angulation of the uterus may be completely reduced. This position may be made permanent by abdominal shortening of the round ligaments, or by an anterior fixation, or by Olshausen's fixation of the round ligaments. We have by this method been able to secure satisfactory results in 75 per cent. of cases.

### MEMBRANOUS DYSMENORRHEA

The appellation "membranous dysmenorrhea" relates to a condition by which at each monthly period the entire uterine mucosa is exfoliated and discharged. The process is not well understood and, consequently, various names have been attached to it. It is commonly classified as a form of dysmenorrhea because in most cases the passing of the membrane is accompanied by severe cramp-like uterine pain. In some instances, however, pain is not present, so that the expression "menstrual exfoliation of the uterine mucosa" is preferred by some. Owing to the fact that the extruded membrane often shows evidences of inflammation, others name the condition "exfoliative endometritis." "Membranous" or "membranaceous dysmenorrhea" is the term most commonly used.

In a typical case there is discharged each month at the menstrual period a bag-like cast of the uterine canal which is three-cornered in form, with openings at each angle, two of them corresponding to the beginnings of the tubal canals and the other to the internal cervical orifice. The outer surface of the sac is rough and shaggy, of a grayish-red color, and represents the submucous tissue where the membrane has been torn from its bed. The inner surface of

the sac is pale, velvety and undulating, and corresponds to the surface of the uterine mucous membrane. The thickness of the membranous wall is 1 to 3 mm. The entire membrane does not always come away intact, but more frequently becomes broken, so that it appears in pieces or shreds of tissue of varying sizes. Careful inspection of these shreds reveals the characteristic surfaces, though to casual observation they often look like washed-out organized blood-clots.

The microscopic picture of the dysmenorrheic membrane is not an entirely constant one. The most distinctive feature is an enlargement of the stroma

Fig. 228.—Membranous Dysmenorrhea.
The tissue is in an early stage of necrosis and stains poorly. The epithelium lining the glands has disappeared. (Low power.)

cells, which gives an appearance very similar to the decidua of uterine or ectopic pregnancy, though, as a rule, the cell enlargement is less marked than in the case of a true decidua. In addition to the change in the stroma cells the gland elements are wider apart than normal and there is usually localized infiltration of small round cells with the characteristic changes of an interstitial endometritis. The surface epithelium is often desquamated. The entire section usually stains more faintly than does normal uterine mucosa. The microscopic appearance however, varies in specimens from different individuals, and in different specimens from the same individual, sometimes showing well-marked

evidence of endometritis sometimes exactly simulating true decidua, and sometimes showing no variation at all from a normal mucous membrane.

It will thus be seen that a differential diagnosis cannot always be made by microscopic examination between membranous dysmenorrhea, early abortion, and extra-uterine pregnancy.

In addition to the typical exfoliated membrane above described, casts and shreds of tissue are sometimes periodically discharged which are composed chiefly of fibrin, with only a scattered remnant of glandular elements to be found in the tissue. Membranes of this kind are apt to show considerable evidence of inflammatory reaction in the form of round cells and leukocytes col-

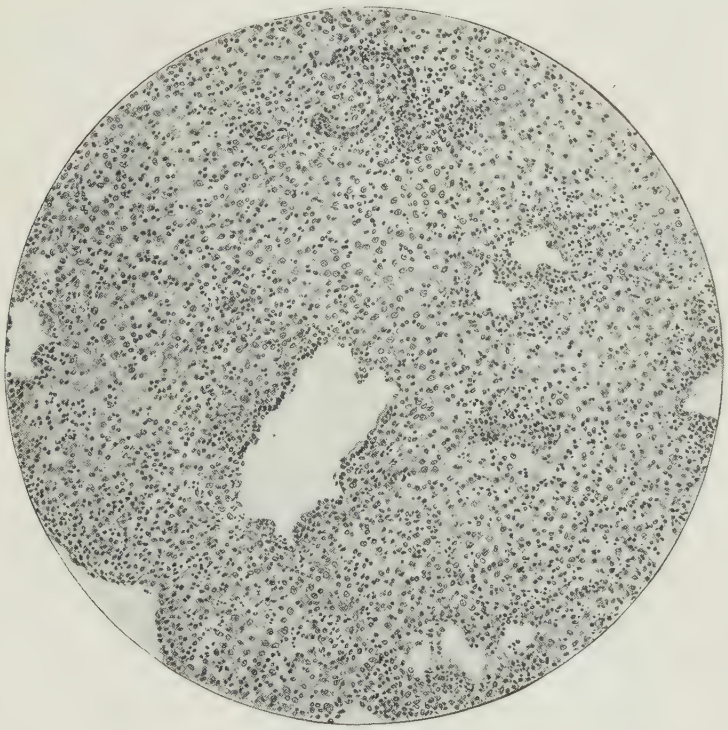

Fig. 229.—Membranous Dysmenorrhea, Showing Necrosis and Infiltration of Leukocytes.

lected in the meshes of fibrin. To this condition has been given the name "fibrinous endometritis."

The **etiology** of membranous dysmenorrhea is very obscure. In a certain number of cases the disease dates back to an abortion. In a few instances an hereditary element is evident. The present tendency is to refer the condition to an abnormal reaction between the ovarian secretion and the uterine mucosa. It has been pointed out (Halban and others) that menstruation, membranous dysmenorrhea, and decidua formation represent different degrees of the same physiologic process—*i. e.*, reaction of the uterine mucosa to the influence of the ovarian secretion.

It is possible that the underlying cause may be ascribed in some cases to an interstitial endometritis which produces an abnormal desquamation at the menstrual flux. This is a plausible explanation for those cases which date from an abortion.

The chief symptoms of membranous dysmenorrhea is catamenial pain, which may be very severe or be only a dull, dragging sensation. Rarely pain is entirely absent.

Many patients are sterile, but sterility is not always present. In one of our cases the patient had an extra-uterine pregnancy about a year after an unsuccessful cureting for the disease.

The **diagnosis** of the affection, as has been noted, cannot always be made with the microscope, even by the most expert microscopist. For this reason the diagnosis of any decidual membrane should never be dogmatically made without taking into consideration the patient's menstrual history.

The **prognosis** of membranous dysmenorrhea, as regards complete cure, is not good, and the treatment is very unsatisfactory. Schaefer (in Veit) reports 2 successful cases in which hydrastis was used.

**Treatment.**—The usual recommendation is that of repeated curetings just before the onset of the menstrual period. At each curetment the uterine cavity is treated with iodin. In our experience it has been difficult to persuade patients to undergo the treatment a sufficient number of times to test its real efficacy.

## AMENORRHEA OF YOUTH

The various pathologic conditions with which amenorrhea is associated, or of which it is a symptom, are enumerated in the section on General Symptomatology. When amenorrhea is one of the manifestations of some organic disease, such as tuberculosis, chlorosis, etc., treatment is directed toward the fundamental disease. In many cases amenorrhea signalizes hypofunction of the ovarian function, and may appear either as an abnormally delayed menarche (puberty) or as a cessation of menstruation that has already been established. An allied condition is that of unnaturally scanty menstrual flow (oligomenorrhea). In many cases of youthful amenorrhea and oligomenorrhea, hypoplasia of the internal or external genital organs can be demonstrated. In many cases, however, no anatomic abnormality is discoverable. Some of the patients are underdeveloped in their general organism, and are of the asthenic, nervous type, while others may be well developed and continue in perfect health.

The specific treatment of youthful amenorrhea consists in the use of the various ovarian or lutein extracts. In our experience we have had marked success with the extract of the entire ovary, given in 5-grain capsules three or four times daily. The effect of this treatment usually appears within three or four weeks. Sometimes menstruation appears in a few days from the time of the first administration.

Amenorrhea and oligomenorrhea have been treated successfully by the use of the intrauterine stem-pessary.

Rieck has reported cures in 19 out of 22 cases, and recommends the treatment in all cases in which other methods, especially the administration of ovarian extract, have failed.

Good results from the treatment are seen in from two weeks to two or three months after the application of the pessary.

Rieck keeps the pessary in the uterus for eight months to a year, even if good results appear early.

The author does not recommend this treatment.

### MENORRHAGIA OF YOUTH

In this category are included those cases of excessive menstruation in which no definite pathologic cause is demonstrable. The condition is sometimes termed "functional menorrhagia." It most commonly appears either at or soon after the menarche, but sometimes it does not become evident until several years after the establishment of the menses. The bleeding in these cases is often very severe and prolonged, and may seriously threaten the life and health of the patient. In time the pelvic organs become much congested and the uterus may become large and flabby, sometimes falling back into the position of retroflexion. Secondary anemia and functional heart disturbances are apt to ensue, and are often regarded as the cause instead of the effect of the uterine bleeding. Present ideas refer the condition to abnormal function of the ovarian secretion, which in some cases is undoubtedly brought about by a disturbance in the balance of the other organs of internal secretions. Hertogue, Duffy, and others consider that it is the result of deficiency in the activity of the thyroid, which when functionating normally counterbalances the effect of the ovarian secretion.

The **treatment** of the menorrhagia of youth and puberty should always at first be conservative. The most promising form of medication at the present time is that of extract of the pituitary gland. The usual dosage is 1 c.c., given subcutaneously every one or two days for an average of ten doses. Experience seems to indicate that this extract is decidedly more effective in the functional menorrhagias of youth than in those of middle life (uterine insufficiency).

The alarming hemorrhages of puberty may be successfully treated by blood transfusion, preferably from one of the parents; or serum from human or horse's blood may be administered subcutaneously, in doses of 15 to 30 c.c., repeated several times. On the theory that the hyperactivity of the ovarian secretion in these cases is caused or stimulated by a deficiency in the thyroid secretion, thyroid extract is recommended in conjunction with pituitrin (Duffy). Calcium chlorid, in doses of 80 grains a day, is recommended.

Local treatment should be resorted to only secondarily. Curetment seems to be of little value. In some of our cases it had no beneficial effect whatever. There is no doubt that in nearly all cases the hemorrhage may be stopped by the use of the *x*-ray. It must be remembered, however, that the effects of the *x*-ray are accomplished at the sacrifice of the ripening follicles of the ovaries. Although it is claimed that with present improved methods the application of the

rays may be so tempered as to check but not destroy the ovarian function, one would hesitate to subject a young patient to the treatment unless all other methods fail. The treatment of youthful menorrhagia by radium is discussed below at length in the section on the Use of Radium in Non-malignant Conditions. With the foregoing measures available, a final resort to surgical castration should be a rare necessity.

## RADIUM IN THE TREATMENT OF NON-MALIGNANT GYNECOLOGIC DISEASES

Radium has become an invaluable resource to the gynecologist not only in the treatment of cancer, but in certain non-malignant conditions, chief of which are the menorrhagias and metrorrhagias of uncertain pathologic origin. In this field of therapy radium has attained its surest position of usefulness, for whereas in the treatment of cancer its ultimate value is still problematic, in metropathic hemorrhages it may be regarded almost as an unfailing specific. So important and satisfactory in its results has radium become in this class of cases that its discovery may perhaps be regarded as marking the greatest single advance that has occurred for many years in gynecologic science. Patients who formerly passed through long periods of continuous or recurrent bleeding, relieved imperfectly or not at all by repeated surgical or medical treatment, many of them coming eventually to hysterectomy, may now often be completely cured by a single application of radium.

Up to the present time the exact manner in which radium acts to control the bleeding of a metropathic uterus has not been conclusively determined. There is no doubt that a sufficient dosage may destroy the primordial and ripening follicles of the ovary and in this way prevent the cause of hemorrhage at its main source. The readiness, however, with which even moderate doses of radium will check bleeding and regulate the menses to normal rhythm and duration makes it probable that some beneficial influence is exerted on the endometrium itself. This problem has not yet been worked out, for the time during which radium has been employed for this purpose has been so short and the opportunities for histologic examination so limited that no searching investigations have been carried out. Clark, in a recent paper, reported a case in which hysterectomy had been performed shortly after an intra-uterine application of radium. A careful microscopic examination of the tissues of uterus and ovaries failed to reveal any distinctive change that might be attributable to the influence of radiation. That there is some tissue like the endometrium outside of the ovaries which is perhaps the principal factor in this form of treatment is suggested by the fact that in some instances the ordinary dosage of radium is insufficient to check the hemorrhage and that enough radium must be applied to destroy the ovarian follicles and cause atrophy of the ovaries (Wood).

**Selection of Cases.—Uterine Insufficiency.**—The treatment of radium for metropathic bleeding may be extended to a wide range of cases. The most

important of these represent the condition which we have described as uterine insufficiency. The majority are patients approaching the menopause, though many are younger. Their symptom is menorrhagia in its various forms. Many have metrorrhagia, sometimes lasting almost continuously for months. With the exception of a greater or less degree of secondary anemia they exhibit no special local or constitutional changes. As we have seen in the section on Uterine Insufficiency the pathology of this condition is not understood. Careful examination of the endometrium reveals no gross or microscopic lesion to account for the abnormal bleeding. Most of these patients when they come to the attention of the gynecologist have been treated to no avail with the various drugs commonly prescribed for uterine hemorrhage. Many of them have been subjected to one or more operations for curetage. Without the help of radium the usual course of treatment is to repeat to a certain extent the measures that have already been

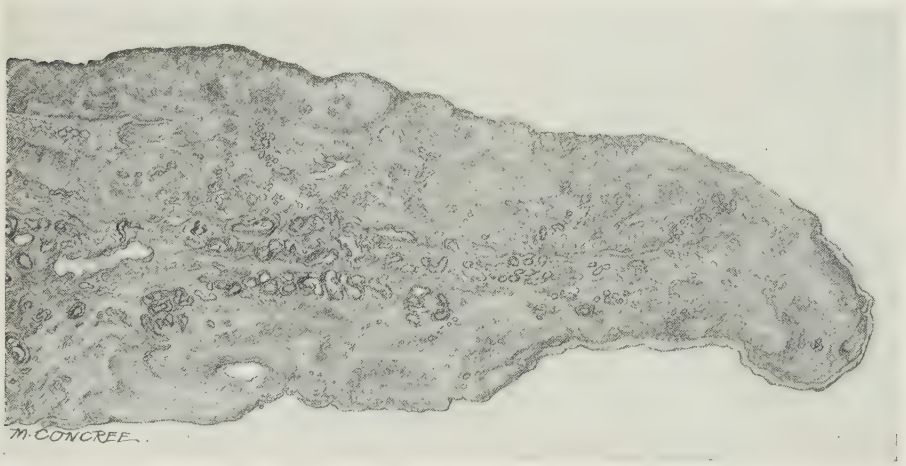


Fig. 230.—Ovary After Radium Treatment.
The ovary is shrunken, sclerotic, and destitute of follicles.

used, including a final curetage. As the bleeding usually continues, a hysterectomy is reluctantly advised and submitted to. In patients of this type radium produces its most satisfactory results, one treatment usually sufficing to effect a permanent cure. The amount of dosage depends on the question whether or not it is desirable to establish a premature menopause. If the patient is at the climacteric age it is often advisable to bring about complete amenorrhea, and this may be accomplished by simply lengthening the time of exposure. If the patient has before her several years of menstrual life it is usually best to give such dosage as will check but not completely arrest menstruation.

A second type of menorrhagic cases, suitable for radium treatment, comprises those patients in whom the hemorrhages are the result of a demonstrable non-malignant disease of the endometrium.

These cases we do not classify under the heading of uterine insufficiency, a

term which is applicable only where microscopic examination of the endometrium shows no abnormal changes. The non-malignant diseases of the endometrium that produce or are associated with bleeding are, for the most part, represented by two types, namely, that which is characterized by some form or degree of permanent gland hypertrophy and that in which there is an interstitial thickening of the endometrial stroma. These two types must be considered separately in their relation to radium treatment.

**Gland Hypertrophy.**—Cases of permanent gland hypertrophy are not easily distinguishable from those of uterine insufficiency, for clinically the symptoms are practically the same, and in many instances there are no palpable signs which may lead to a differential diagnosis. In the more marked forms the uterus is enlarged and boggy, often in some degree of retroposition. In these cases the endometrium may be greatly thickened even to the extent of half an inch or more and hangs down in irregular folds or polypoid projections. It is frequently associated with multiple polyps of the endocervix, the observation of which may often suggest the diagnosis of the condition of the endometrium.

Permanent gland hypertrophy may occur at any period of menstrual life from adolescence to the menopause, but it is more common after the age of thirty-five. Its obscure etiology is discussed elsewhere (see Gland Hypertrophy). Patients with uterine bleeding from gland hypertrophy are all suitable subjects for radium treatment with the exception of the rare cases in which the hypertrophic endometrium has reached the adenomatous stage or where great cystic degeneration has taken place. It is, therefore, not necessary to have made a previous differential diagnosis between the condition and that of uterine insufficiency. The existence of a diseased endometrium is usually first discovered during the preliminary cureting which should always for purposes of exploration precede an intra-uterine application of radium. The difference between an abnormally hypertrophied mucous membrane and certain phases of the normal endometrial cycle can be learned only by experience. When a thickened polypoid mucosa is found it is of very great importance to distinguish it from cancer of the uterine body. As a rule the diagnosis is readily made from gross inspection of the tissue. In gland hypertrophy the mucosa is removed by the curet in long solid strips or in smooth polypoid masses, with comparatively little bleeding. If cancer is present the tissue appears in friable pieces, with bleeding usually more marked. If the case is one of polypoid hypertrophy it is advisable to make a thorough cureting of the uterine cavity before inserting the radium, for in this way not only is the treatment likely to be more efficacious, but it helps to avoid the leukorrheal discharge and passage of shreds which otherwise may ensue. If the mucosa is apparently normal the curetage need not be more than to secure enough tissue for examination. If there is doubt as to the diagnosis between hypertrophy and cancer, the cureted tissue should receive immediate microscopic examination. If it proves to be cancer the radium should be removed as soon as the fact becomes known.

If during the cureting the tissue removed is obviously cancer the curetage should not be carried further than is necessary to secure an abundance of material for microscopic examination, and radium should not be used, for neither the curetage nor the radium are of benefit for the radical operation that is now indicated. The reasons for not treating cancer of the uterine body are given in the section devoted to that subject (*q. v.*).

**Interstitial Endometritis.**—A thickened mucosa due to interstitial hypertrophy and lymphatic infiltration of the endometrial stroma cannot be distinguished by gross inspection from permanent gland hypertrophy or even from the hypertrophic phase of the normal mucous membrane. We have on a few occasions applied the radium treatment without harm in cases where the cureted tissue has in the later microscopic examination revealed an interstitial endometritis. The inability to detect by sight a chronic or even an active inflammation of the mucosa constitutes a point of weakness in the radium treatment of metropathic hemorrhages. If the inflammatory process is confined to the endometrium it is probable that no injury will result from the action of the radium. Inflammatory conditions of the mucosa are, however, apt to be associated with latent inflammations of the pelvis, which may not be detected by bimanual examination, and which, as we shall see, are susceptible of being lighted into activity under the influence of radiation.

**Menorrhagia of the Young.**—In treating the menorrhagias of youth radium has proved exceptionally valuable. Operators hesitated at first to employ radium in these cases on account of the danger of establishing permanent amenorrhea and sterility. This difficulty has now, for the most part, been obviated by an improved knowledge in the technic of application, so that it is possible by proper dosage to regulate abnormal menstrual activity with surprising precision.

The etiology of menorrhagias of youth is as obscure as of those occurring in middle life. It is quite probable that much the same factors determine their causation. In some no demonstrable pathology can be found and the condition simulates closely that to which the term "uterine insufficiency" has been applied. Others exhibit a pronounced endometrial hypertrophy which is peculiarly persistent and prone to rapid recurrence after curetage. In a few cases of girls under the age of twenty we have found the Wassermann reaction positive. Youthful masturbation is undoubtedly a predisposing factor in some. Whatever the underlying cause, the metropathic hemorrhages of the young have been particularly baffling to the gynecologist, for not only are drugs and the usual curetage, for the most part, ineffectual, but the final resource of hysterectomy or castration is a much more lamentable outcome than in older women.

So far as present observations have gone it seems entirely feasible to treat young patients with modified doses of radium. So little work in this field has been done that there is no standardized dosage. It is important to be extremely conservative and in general to observe the principle that the younger the patient,

the smaller should be the dosage, notwithstanding the dictum of some of the more experienced operators that in younger women uterine hemorrhage is more resistant to radium than in the more mature. On account of the danger of producing permanent amenorrhea it is better to give a small dosage even if it is necessary to repeat the treatment. A number of our cases have been young married women who, in addition to uterine bleeding, have complained of sterility. In a case of this kind the utmost conservatism must be used, for the production of amenorrhea in such a patient would be a disaster for which the operator would hardly be forgiven. Whenever radium is used to regulate menstruation even with small doses a temporary amenorrhea or oligomenorrhea may appear sometimes after the second or third month following treatment, and of this the patient should previously be warned. In the treatment of the menorrhagia of pubescence or early adolescence, radium is a valuable resource, but should be resorted to only in intractable cases. The dosage in our practice is from 100 to 300 mg. hours.

**Menorrhagia of Fibroids.**—The treatment of bleeding fibroids with radium is a subject concerning which there is at present much discussion. The use of the *x*-ray for fibroids met with comparatively little favor in this country, but since the advent of radium opinions regarding the influence of radiation on these tumors has been considerably modified. This is due to the great superiority which radium has over the *x*-ray in treating uterine hemorrhages. The *x*-ray depends for its effects on its destructive action on the follicles of the ovaries, inasmuch as it cannot as readily be applied directly to the uterine mucosa. Radium, on the other hand, although in sufficient dosage may create a similar effect on the ovaries, undoubtedly in small doses directly applied acts on the endometrium entirely independently of the ovaries. This separate action is of great importance, especially in the treatment of fibroids, for it has been frequently demonstrated that the uterine is, in part at least, independent of the ovarian function. This has been shown in the past by the frequent failure to check myomatous hemorrhages by the obsolete method of castration.

As has been stated above, the exact nature of the action of radium on the endometrium is not yet known. Abbe considers it the result of secondary beta rays, which he claims "exert a powerful inhibitive action on new tissue and particularly on its blood-vessels." According to this theory radium acts on the endothelial cells of the capillaries, probably leading to their obliteration (Ransohoff).

The influence of radium on myomatous hemorrhage is prompt and sure, and for this reason the treatment is becoming more and more popular. Some are so enthusiastic as to believe that radium should in most cases supplant operation. Most operators are, however, more conservative and employ it only in selected cases. Radium has the power of producing a greater or less amount of shrinkage in myomas to which it has been exposed. How far this action may be relied

upon in a given case has not yet been accurately determined. Some claim that it is practically constant.

Many of the dangers entailed in the *x*-ray treatment of fibroids, such as degenerations, necroses, adventitious burns, etc., are, for the most part, negligible in using radium.

With these advantages in its favor radium may be regarded as comparatively safe. It is, therefore, a valuable asset in the treatment of such cases of myoma which cannot be operated on on account of the patient's physical condition, and in cases of small fibroids which are producing no other symptoms than bleeding.

At the present time most surgeons are conservative in its use. Our personal views in the matter may be summed up as follows:

All large fibroids, whether giving symptoms or not, should be subjected to surgical operation unless there is some constitutional contraindication. If such is the case, large bleeding fibroids may be treated with radium. The application of radium merely for the purpose of reducing the size of the growth is not recommended except where surgery is completely out of the question and the exigencies of the case require that something be done.

In bleeding or degenerating fibroids after the menopause surgery should be employed except in case of stern contraindications of a constitutional nature.

Fibroids which are producing pressure symptoms should be operated on. These comprise especially those that are growing low in the pelvis, including cervical myomas.

Myomatous polyps should be removed by surgery.

In the case of comparatively young women with growing fibroids, who desire children, the operation of myomectomy is advisable when possible. In cases of this kind radium is valuable to use afterward to check the menorrhagia which sometimes recurs even after the myoma has been removed.

In cases of uterine hemorrhage associated with small myomata radium treatment is always justifiable and in most cases advisable, in patients approaching the menopause.

When uterine myomata are complicated with a pelvic inflammation, radium is out of the question.

Myomata associated with adenocarcinoma require surgical operation. (See also Treatment of Uterine Myomata.)

**Menorrhagia of Pelvic Inflammation.**—A few cases have been reported in which after radium treatment for non-malignant uterine bleeding a serious, acute pelvic inflammation has rapidly developed after the application. This is undoubtedly a manifestation of the power which radium possesses of stimulating latent inflammatory processes. We have already seen how such an outcome may follow the use of radium in cervical cancer. The clinical course of such a case is exactly similar to that which is often seen after the injudicious cureting of an

inflammatory case. It might be said, therefore, that the real harm is done by the preliminary curetage and not by the radium. This may to a certain extent be true, but that the radium is an active agent in the process is shown by similar results following radiation of cancer where the curet has not been used.

Menorrhagia is a frequent accompaniment of chronic pelvic inflammation and may occur in patients in whom the disease of the adnexa cannot be detected by the most careful examination. With our present limited knowledge of the technic of applying radium, it should never be used in inflammatory cases. The fact that such cases may escape notice should always be in the mind of the operator. Fortunately, a searching clinical history coupled with a careful examination will, with few exceptions, reveal the presence of adnexal disease.

Besides the menorrhagias, other non-malignant gynecologic diseases are said to be susceptible to radium treatment. Most important of these is endocervicitis. Some operators, notably Curtis of Chicago, report favorable results. On account of our inexperience in treating this condition with radium, and in view of the theoretic dangers involved in such treatment, we are not now in a position to recommend it. As endocervicitis is, for the most part, the result of bacterial infection, radium would hardly appeal to one as a logical means of treatment in view of its usual behavior in the presence of inflammatory processes. An additional objection to making a direct application of radium to the endocervix is the possible danger of creating an atresia of the canal. This mishap has been reported following treatment of the endometrium, where the tube containing the radium has accidentally slipped into the cervical canal.

The treatment of "endometritis" with radium has also been recommended. From what we have seen of the literature on this subject the writers plainly employ the term in its older sense and include such cases as we have classified under gland hypertrophy, which does not represent a true infection. For a true endometritis of infectious origin radium would, of course, be contraindicated.

There is excellent authority that radium may be used beneficially in the treatment of pruritus and kraurosis vulvæ.

**Details of Treatment.—Dosage.**—For the menorrhagias of women who are at the climacteric age, most authorities recommend the application in the uterine canal of 50 mg. for twenty-four hours. Some claim that this dosage insures a complete menopause, but in our experience such is not always the case, though abnormal bleeding is almost invariably checked. On account of the menopause symptoms, chiefly hot flushes, which this dosage is apt to set free, we are accustomed to apply 50 mg. for twelve or fourteen hours in the average case, without attempting to establish a complete menopause, and reserve the maximum dosage for the more severe cases or those where the full cessation of the menstrual function is for one reason or another desirable.

In women of thirty-five to forty we employ a dosage of 50 mg. for eight to ten hours. In patients twenty-five to thirty-five years of age our average dosage

is 50 mg. for four hours, but this is increased or diminished according to the exigencies of the case. If the patient is less then twenty-five years of age we reduce the amount of radium to 25 mg. and apply for three to six hours.

This schedule is offered not as an ideal standard, but only as the scale that we are at present using with apparent success. Our inclination is toward gradually lessened dosage.

**After-care.**—Following intra-uterine applications of radium very little after-treatment is necessary and the patient is ready to leave the hospital in three or four days. As a rule there is more nausea and headache than would be expected after the small amount of anesthesia necessary for the application of the radium. Sometimes the nausea ceases as soon as the radium is removed. Occasionally it persists for two or three days.

The patient should not be allowed to urinate while the radium is in the uterus, for the vaginal packing in the vagina becomes immediately soaked with urine which may drain into the uterine cavity along the rubber tubing that contains the radium. If the application is for eight to twelve hours the patient can usually retain her urine until the radium is removed. If the patient is unable to retain the urine or the application is to be continued more than twelve hours the bladder should be catheterized.

The patient should always be told that she may have a certain amount of leukorrhea following treatment. Sometimes this is considerable and it may persist for five or six weeks. Vaginal douches should be prescribed while the leukorrhea lasts.

During the first few days some patients complain of vague pelvic pain referred to one or the other side. We have not been able to explain the cause of this pain. It soon passes away and is not a serious complication.

Patients should also be warned that there may be some appearance of blood during the first few weeks after the treatment. This is usually in the form of an occasional faint show. Sometimes the first period following even a maximum dose may be very profuse.

One of the most distinctive after-effects is the appearance of hot flushes. They may occur even in cases where complete amenorrhea has not been established. They indicate the influence which the radium exercises on the ovarian tissue. The symptom responds readily to ovarian extract.

It may happen in treating young women that a condition of menorrhagia may from overdosage be converted into one of oligomenorrhea. For these patients ovarian extract in the form of a preparation of the whole ovary or of ovarian residue may be given in 5-grain doses three or four times daily. The treatment may be continued indefinitely if necessary.

The same treatment is indicated if by chance amenorrhea should be unintentionally brought about.

## VAGINISMUS

By "vaginismus" is meant an involuntary spasm of the sphincter cunni and other muscles of the pelvic floor awakened by attempts at coitus or digital examination. The spasm is usually accompanied by a violent contraction of the adductor muscles of the thigh and a sudden drawing back movement of the pelvis.

This spasmodic shrinking from contact with the vulva may be due to an actual hyperesthesia of the external parts caused by some painful lesion, or it may be due entirely to a psychic reflex.

In the present acceptation of the term, especially since the researches of Walthard, true vaginismus is applied only to those cases in which the manifestation is purely psychic. In the other cases the term "pseudovaginismus" is more properly employed.

*Pseudovaginismus* may be produced by a variety of affections which make introition painful, most important of which are urethral caruncle, inflammation of Skene's glands, hard unresisting hymen, fissure of the vaginal mucous membrane, inflammation of Bartholin's gland, soft chancre, and other ulcerations of the labia, shrinking of the vaginal opening from senile atrophy or from castration, and cicatricial bands following improperly performed operations on the perineum.

In all these cases contact of the male organ or of the examining finger is exquisitely painful, so that the patient naturally shrinks away to avoid pain. The spasmodic movement may, therefore, be regarded as physiologic, in the sense that it implies no abnormal psychic process.

In *true vaginismus*, on the other hand, there is present usually no real hyperesthesia of the parts, the muscular spasm being the result of a mental reflex. It is often exhibited before actual contact with the vulva takes place. The cause of the reflex rests in the imagination and consists of the fear of being hurt. In many cases the trouble dates back to some early painful attempt at coitus, or to a rough digital examination, the remembrance of which produces a lasting fear of contact. Other causes are the fear of becoming pregnant, personal dislike of the man, or an inborn abhorrence of the sexual act, such as is not infrequently seen in women of the hypoplastic or old-maid type. In the examining room it is not infrequently found to be the result of shame and the fear of detection.

Abnormal practices, like masturbation and coitus interruptus, frequently lead first to frigidity and then to true vaginismus.

True and false vaginismus are, of course, closely related, and it may sometimes be difficult to say which name is applicable to a given case, as, for example, in a masturbator with secondary vulvitis. This is especially true of women of

middle age, who acquire vaginismus after an ill-judged operation on the perineum or following hysterectomy and castration. Here the process is due to an atrophy and shrinking of the tissue at the introitus which is constantly uncomfortable, yet is not actually tender to the touch. Severe and intractable vaginismus may, however, be present. In these cases the psychic reflex is maintained by the constant subjective discomfort of the perineum. If the discomfort of the perineum can be eliminated the vaginismus disappears.

The **treatment** of pseudovaginismus is directed toward the particular lesion which causes pain, and the cure of the vaginismus is, as a rule, directly dependent on the cure of the offending lesion. Sometimes, however, the patient acquires a habit neurosis and the fear of coitus persists, the case becoming then one of true vaginismus.

The treatment of true vaginismus is a matter of great difficulty and may require the help of an expert psychotherapeutist. It must first be determined by digital examination and inspection whether there is any objective cause for the affection. Examination of these patients is a supreme test of skill, patience, and tact on the part of the physician. If the patient makes the examination impossible, it is necessary to resort to an anesthetic. If the examination without ether is roughly or impatiently done the vaginismus may be made very much worse. On the other hand, if the confidence of the patient is gained and a successful examination is carried out, so that the patient is convinced that there is no real tenderness of the parts, it may result in a complete cure.

In order to accomplish this Walthard recommends a method of examination from which he claims much success. On the theory of the antagonism of the abdominal muscles to those of the pelvis he brings about an "innervation" of the former by getting the patient to exert powerful abdominal pressure by straining down. In this way the muscles of the pelvic outlet are deadened so that there is no difficulty in passing the finger or an instrument into the vagina. The patient, finding that there is no real pain, thus loses her fear of being hurt, which is the chief cause of the vaginismus.

In the case of vaginismus due to senile atrophy of the perineum the author has had success with ovarian extract.

In the hypoplastic type of women stretching the introitus may help in some cases, but, as a rule, it is of little value. These cases are, for the most part, incurable. Fortunately, they do not usually marry.

Many of the cases that are due to powerful mental influences can best be treated by an expert neurologist.

**Dyspareunia** is a word somewhat loosely used to cover all forms of unpleasant coitus, and, therefore, commonly includes both true and pseudovaginismus. In its strictest sense, however, it denotes merely lack of pleasure in coitus and implies absence of orgasm. In this sense dyspareunia is dependent on defective excitability of the clitoris. It may be caused by functional insensibility of the pudendal nerve, or of deficient excitability of the genitocerebral ganglion

or of the genitospinal ganglion (Rohleder). The same result may be produced by interruption of conduction from tabes, transverse myelitis, etc.

Functional insensibility of the clitoris may be inherent and permanent, the woman never experiencing the sensation of an orgasm. Many women of this type show no local or general defect of development and often bear children. They are often affectionate and exhibit sexual desire, but are incapable of orgasm.

In many women affection toward the man plays a very important part. Such a woman may be sexually insensitive for years, and then, upon contracting a new and more congenial relationship, awake to a high degree of excitability. There is no doubt that a large percentage of women acquire a normal sensibility of the clitoris only after weeks or months of married life.

Dyspareunia may be due to masturbation. In this case the clitoris is insensitive only in coitus. In other cases it is due to premature ejaculation or impotence on the part of the husband.

Sexual insensibility follows in about 20 per cent. of cases after hysterectomy and castration. If treatment of dyspareunia is necessary, it is best carried out by applying electricity to the clitoris. (See also section on Sexual Impulse.)

## GYNATRESIA

Atresia of the vagina relates to a complete closure of the vaginal canal. The closure may take place at any point of the vagina from the cervix to the hymen, or it may constitute an obliteration of the entire canal. It is quite commonly believed that most atresias of the vagina are the result of some congenital defect. This has been shown to be an error, and it is now known that in the great majority of cases the closure is the result of an inflammation and ulceration of the vaginal walls, during the healing of which the contiguous surfaces of the vagina become permanently adherent.

A study of the embryology of the genital system proves that with a normally developed uterus there can be no defect of the vagina, excluding the cases of double formation. When there is absence of the vagina the upper portions of the genital tract are necessarily rudimentary and do not functionate. Congenital absence of the vagina is, therefore, symptomless.

Conversely, atresia of the vagina, accompanied by symptoms of obstructed secretions, implies a full development of the genital system, and the closure of the vagina, must, therefore, be considered acquired (Veit).

There is one exception to this (Veit). It is evident that there may be a union of the epithelial surfaces of the hymen before birth in the presence of normal development of the rest of the genital tract. Whether this closure is due to an intra-uterine infection, or whether it is a congenital defect, has not been definitely settled. This form of atresia is seen in the newborn, and makes its

appearance by the extrusion of a tumor from the labia, consisting of blood-stained secretions retained behind the occluded hymen, which is stretched out into a thin membrane by the pressure of the fluid. Evacuation of the fluid contents by incision of the membrane is imperative within a few days after birth.

According to Veit, intra-uterine closure of the hymen is always evident at the time of or soon after birth, and cases that produce symptoms later must be regarded as the result of an acquired atresia.

There is also one other apparent exception to the statement that a development of the lower vagina cannot exist with rudimentary internal genital organs. In cases of deficient vagina it is not infrequently observed that attempts at coitus may create a blind pouch in the vulva that suggests a true vagina.

The ways in which the vagina and hymen may become closed as the result of plastic healing of inflammatory processes are numerous. In children the atresia usually takes place either at the hymeneal opening or at the junction of the middle and outer third of the vaginal canal, where the anterior and posterior surfaces lie most intimately together. The causes assigned for this process are necessarily some of them theoretic, but entirely plausible. The mucous membrane of the vagina and vulva in childhood is very delicate and plastic. It may well be imagined that chafing and erosion at the small opening of the introitus irritated by the urine, or infected by thin fecal material, might easily result in gluing together of the edges of the hymen or even of the surfaces of the labia minora. The injury to the surface epithelium might be the result of trauma, like that of falling astride a fence, or it might be from masturbation, or even from the chafing of muscular movements. Atresia at the introitus results in a thin membrane when pressed upon and stretched by the obstructed secretions.

In atresia that takes place inside the vagina there is a broader area of adhesion, which varies from a narrow strip of adherent surface to one whose width includes nearly the length of the vaginal canal. The membrane or diaphragm stretched out by the secretions is thicker and more cicatricial than that of hymeneal atresia.

*Stenosis of the vagina* is produced by the same causes as atresia, and relates to a condition where the obstruction is not complete. When due to an early vaginitis an annular constricting ring of scar-tissue may be felt, through which the finger can usually be passed. Severe lacerations of the vagina from instrumentation at childbirth may be followed by extensive obstructive scarring of the vagina, the scars sometimes extending into the parametrium. Partial atresia from senile vaginitis is very common.

The effect of cicatricial stenosis of the vagina is to cause incomplete drainage of the secretions, which become stagnant and chemically altered. The result is an irritating leukorrhea. This is a not uncommon cause of pruritus and kraurosis.

A most important danger from cicatricial stenosis of the vagina is that from dystocia.

As has been said, occluding adhesions of the vaginal walls presuppose some form of ulcerative vaginitis. The most important and severe form of vaginitis that occurs in childhood is that caused by the gonococcus. The vulva and vagina in childhood is extraordinarily susceptible to this organism, and infections easily take place from unclean towels, sponges, bed-linen, etc. The resultant inflammation is usually productive of profuse suppuration and tendency to plastic adhesions. One observer (Fränkel) asserts that the symptoms of gonorrheal vaginitis in children may be so slight as not to be noticeable, and that in this way many unaccountable atresias take place. This seems reasonable when one considers the extensive occluding processes which the disease may produce in other tissues with almost inappreciable symptoms.

It has been shown that various general infectious diseases may cause inflammatory and ulcerative processes in the vagina, such as scarlet fever, diphtheria, typhoid, and even measles, and it is not unlikely that many cases of vaginal atresia in childhood are referable to these diseases.

Veit cites several interesting cases to show how readily the hymen may become closed. In one case at the end of pregnancy a complete atresia of the hymen was found. Others of a like nature are quoted. In another case, a girl of twenty had menstruated regularly for several years and then became amenorrheic. It was found that she had acquired an atresia of the hymen with a hematocolpos. In adult life atresia of the vagina may be the result of severe lacerations and inflammations of the vagina following the instrumentation of childbirth.

After the menopause, senile vaginitis may result in atresia of the vagina and more often atresia of the cervix. In this form the occlusion is more apt to occur at the upper portion of the vagina. The process of atrophy obliterates the posterior vaginal pouch and makes the vagina conical. The plastic process of the chronic inflammation tends to glue the walls to the cervix and narrow or close the vaginal lumen near the external os.

**Symptoms.**—Hymenatresia of the newborn is attended with a backing up of the secretions in the vagina and consequent protrusion of the obstructing membrane. This is due to the fact that the uterus is stimulated at birth to hypersecretion and even bleeding, probably through the agency of the placenta. After birth the uterus usually remains inactive until puberty, so that postnatal acquired atresia does not produce symptoms until that time, although a few cases have been reported where non-hemorrhagic secretions have collected behind the closure and required attention before the onset of menstruation.

Usually the affection first makes itself evident when the patient has begun to menstruate. Each month there occur the molimina of menstruation attended with severe cramp-like pains in the lower abdomen and back. Sometimes there are no subjective symptoms until so great a mass has collected as to cause pressure.

The onset of symptoms may be very acute, simulating those of a ruptured ectopic pregnancy. The abdomen on being opened presents a large amount of tarry blood issuing from the tip of one of the fallopian tubes. The picture is like that of a ruptured hematosalpinx described on the next page, excepting in this case the menstrual reflux into the abdomen takes place at the first menstruation, and is not gradually accumulated in a closed sac.

If the atresia is at the hymen or low in the vagina the obstructed menstrual blood and uterine and cervical secretions collect in the vagina, forming a so-called "hematocolpos." The atretic membrane is ballooned outward between the labia, while the mass in the vagina may reach an enormous size. In time the cervix becomes stretched out, and eventually the uterus is filled and distended with blood, forming a hematometra.

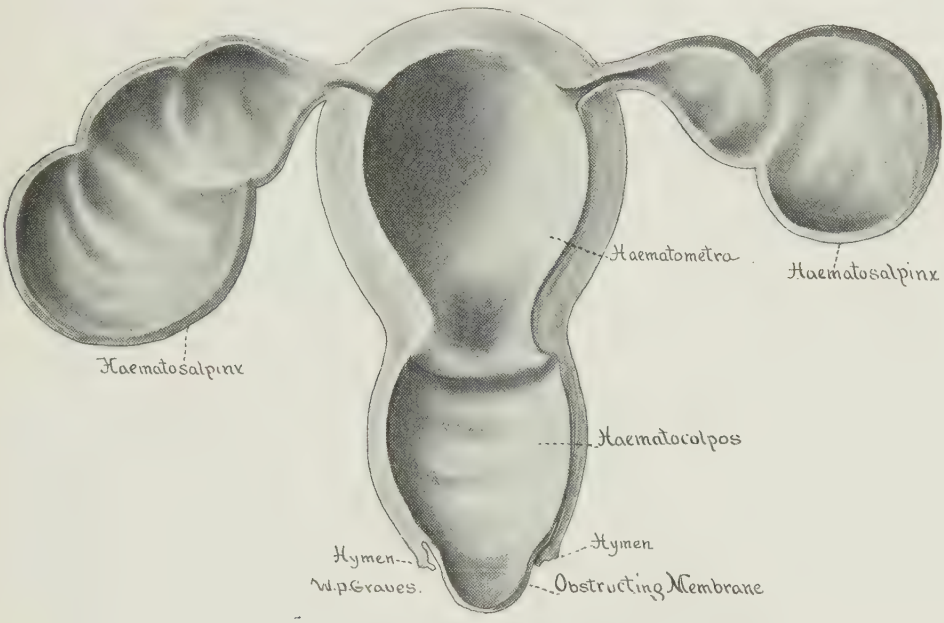


FIG. 231.—ACQUIRED ATRESIA OF THE VAGINA OR HYMEN.

A semidiagram showing the cavities formed in the genital tract by the obstructed menstrual blood. Hematocolpos in the vagina, hematometra in the body of the uterus, and hematosalpinx in the tubes.

A later and more serious manifestation is the formation of a hematosalpinx on one or both sides. The hematosalpinx is produced by a closure of the ostium and an exudation of blood into the lumen. This blood comes partly from the flow from the uterus and also, as has been proved, from hemorrhages from the tubal mucosa. How the tubal ostium becomes closed is a matter of some doubt. Some believe that it can only be explained as a part of the original inflammatory process which caused the atresia of the vagina. Others maintain that the tubal end may become closed without the agency of infectious micro-organisms by the clotting and organization of blood, as sometimes happens in tubal abortion. Others think that the epithelial lining of the ends of the tubes desqua-

mates as a result of chronic congestion and thus favors adhesion. Thoma believes that the collection of blood in the genital organs decreases the absorptive power of the pelvic peritoneum, which is kept in a condition of chronic irritation by the repeated exudation on its surface of menstrual blood. Thus, adhesions are formed from chemicotraumatic influence. The hematosalpinx may become adherent to the intestines and be infected. The contained blood undergoes a characteristic change. The blood-corpuscles shrink and the blood itself becomes thick and syrupy, assuming a chocolate appearance. If infection takes place the hematosalpinx is converted into a pyosalpinx.

The long-retained blood is very toxic, and in some cases probably contains pathogenic micro-organisms, for if rupture of the tube occurs the event is apt to be fatal, either from peritonitis or toxic absorption. The rupture may be followed by shock and death like that from a ruptured tubal pregnancy.

The **diagnosis** of atresia during puberty is usually obvious. Periodic molimina of menstruation, with pain and no appearance of blood, occlusion of the vagina, and pelvic mass felt by rectum, form a characteristic clinical picture. It is, however, not always easy to judge the extent of the trouble, especially as regards the involvement of the tubes. The large abdominal mass is sometimes indefinite and the distended organs cannot readily be differentiated.

**Treatment.**—Atresia of the hymen and vagina should *always* be treated by a radical operation—*i. e.*, complete excision of the occluding membrane—except where there is atresia of the entire canal, in which case such an operation is, of course, not feasible. The contents of the vagina and uterus should then be thoroughly evacuated under the most careful aseptic precautions. By entirely excising the membrane free drainage is established and the patient is in little danger of sepsis. Moreover, there is no danger of recurrence of the atresia. The common practice of opening the membrane by a crucial incision without further operation is very much to be condemned. This method does not provide free drainage and sepsis ensues without fail. The sepsis may be fatal or it may lead to a long process of chronic vaginitis, with continuous foul leukorrhea from the partially retained secretions. Moreover, the incised wound made by the scalpel through the membrane soon contracts to a small opening which further hinders free drainage. The proper method of excising the membrane is shown on page 713.

If the surfaces of the vagina have grown completely together the separation of the two walls may leave them with little or no epithelial covering. The problem then becomes a very difficult one, for it sometimes is impossible to keep the lumen from closing up without grafting a new epithelial covering. This may be accomplished by turning in flaps from the labia minora and thighs, as depicted on page 716. Even this may not be feasible, and it may become necessary to perform a complete hysterectomy.

If hematosalpinx is present the condition is to be regarded as very serious. This requires an abdominal operation in addition to the vaginal operation for

removal of the membrane. The question then arises as to which operation to do first. Opinions differ in this respect. In our own practice we prefer to do the vaginal operation first, partly because one cannot, as a rule, be perfectly sure as to whether or not hematosalpinx is present, a diagnosis of which can easily be made after the vagina has been opened. A second reason is that the pelvic condition may require a hysterectomy, which if done first would result in spilling the blood contained in the uterus and vagina into the peritoneal cavity.

In operating on young girls for hematosalpinx it is important to be conservative if possible, but the extent of the operation must be determined by the exigencies of the case.

In treating the hematosalpinx it is safest to regard the case as one of sepsis and to leave in a precautionary drain in the lower end of the abdominal incision. Drainage should *not* be established through the vagina, as in the usual case of pelvic sepsis.

Atresia sometimes occurs on one side of double uterus and vagina. The closure may be the result of congenital union or it may, like atresia of the simple vagina, be acquired, and in the same way. In this type of atresia the hematometra and hematosalpinx are one-sided, with consequent unilateral symptoms. The diagnosis may be quite obscure, as the other uterus may menstruate normally without obstruction.

The treatment is removal of the offending organ by a laparotomy.

The treatment of stenosis is to excise the scar-tissue as completely as possible. It is important to sew up the wounds in the vaginal wall in such a way as to avoid causing a new constriction. This requires ingenuity and knowledge of plastic surgery on the part of the operator. It most cases it is possible to restore the vagina to its normal caliber and consistency, but the scars may be so deep as to make the operation dangerous and the results unsatisfactory.

The treatment of congenital absence of vagina is indicated when it is desirable to create an artificial vagina for the purposes of cohabitation. Many women with absent vagina and rudimentary internal genitals are perfectly developed as regards their secondary sexual characteristics, and are endowed with normal sexual inclinations and sensibility. Such patients are often ready to take any risk in order to become marriageable. The various operations for establishing an artificial vagina are described in Part III.

## GENITAL ATROPHY

The clinical importance of the pathologic changes that may result from atrophy of the female genitals is not sufficiently recognized, and for that reason, in order to direct attention to it, a special section is devoted to the subject.

Under normal physiologic conditions senile involution of the internal and external genital organs begins at the time of the climacteric, and proceeds gradually to degrees varying in different individuals.

In the uterus the muscle elements of the wall diminish and become proportionately less than the connective tissue. The entire organ becomes shorter, thinner, and more flaccid, finally shrinking to a mere sac, while the surface assumes a pale and anemic appearance.

The position of the atrophied uterus is always that of the second degree of retroversion—*i. e.*, pointing in the direction of the axis of the vagina, and the axis of the uterus is practically straight.

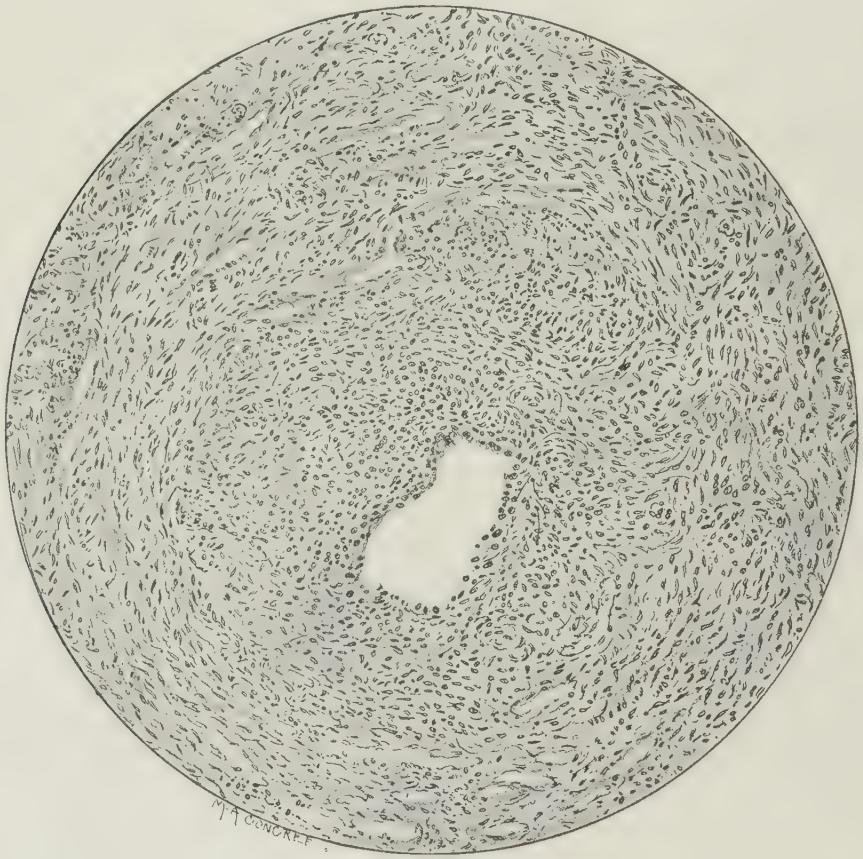

FIG. 232.—ATROPHY OF THE TUBE.

Low power near junction of middle and isthmic portions of the tube. The villi have disappeared, leaving a nearly round lumen which is lined by a layer of low epithelial cells which are inactive. There is a distinct layer of connective tissue taking the place of the stroma of the villi between this epithelial layer and the muscular wall of the tube.

The mucous membrane shares in the general involution and becomes thin and smooth. The glandular elements diminish in size and number and finally disappear altogether, while the ciliated surface epithelium is transformed to a low cuboidal type without cilia. The stroma of the endometrium shrinks and takes on the spindle-form type of connective tissue. The cervix becomes smaller and less prominent, and in time may appear only as a dimple in the vault of the

vagina. The uterine canal also diminishes in caliber, and may become partially or completely obstructed. The tubes are shorter and straighter, while the ovaries shrivel up into insignificant bundles of connective tissue, with complete disappearance of the follicles.

The folds and rugæ of the vagina flatten out, and the vault of the vagina, formerly broad and pouch-like, becomes narrow and pointed, with gradual obliteration of the receptaculum. The vaginal secretion after the senile change becomes alkaline instead of acid, and, therefore, less hostile to pathogenic bacteria. The introitus shrinks to a smaller caliber, and if there are scars from old operations they contract into cord-like bands.

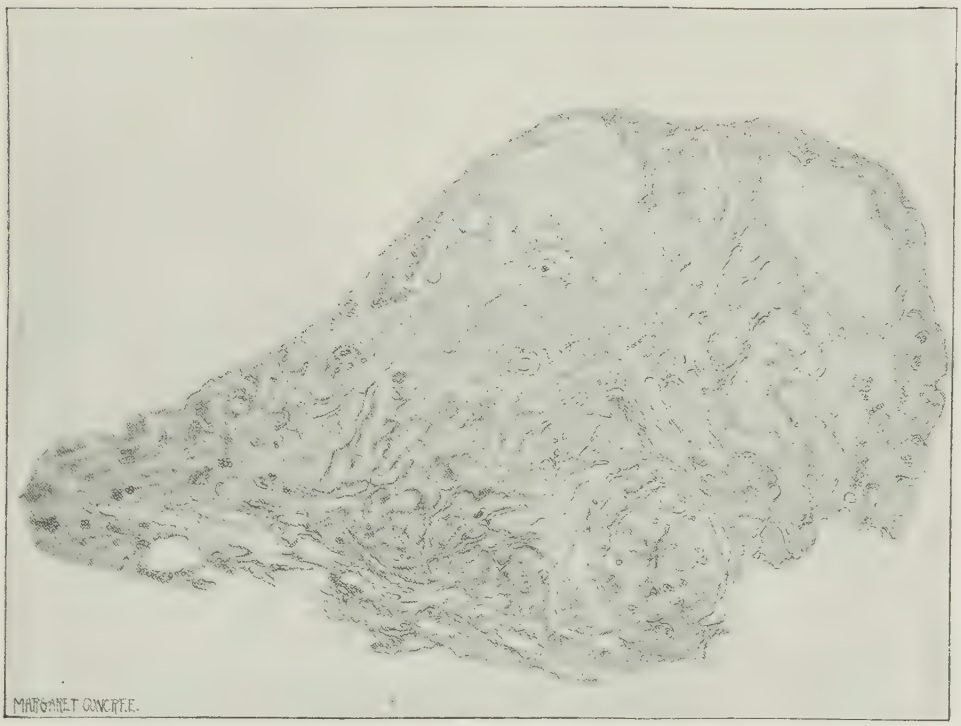

FIG. 233.—ATROPHY OF THE OVARY.

Very low power. Section of the whole ovary, showing at the bottom the hilus, which contains many blood-vessels having thick walls and undergoing obliteration. At the top are many corpora albicantia. The cortex is thin and poorly defined.

The external genitals show a marked change. The labia majora lose their rotund contour and become flat and wrinkled. The labia minora become thin and flat and gradually diminish in size until they disappear. The epidermis of the vestibule and labia minora assumes a pale anemic appearance and becomes dry and inelastic.

Senile involution of the genitals usually does not make its appearance until after the age of forty, but moderate grades of it are sometimes seen even at the age of thirty in women who show no other abnormality.

Another form of physiologic atrophy is that which to a greater or less degree is always associated with lactation and is most noticeable in the uterine wall. This is practically a hyperinvolution, for it has been shown (Saenger) that the smaller size of the uterus is due not to a destruction of the musculature, as in senile atrophy, but to a diminution in size of the separate muscle-fibers. When lactation ceases, therefore, the uterus normally regains its former volume. During lactation the uterus is soft and flaccid and easily punctured or lacerated, a point to be remembered if surgical instrumentation is required during that period.

Lactation atrophy probably always includes to some extent all of the genital tract, but it may be so slight as not to be particularly noticeable. If, however, a plastic operation is performed on the external genitals at that time the lack of elasticity of the tissues is usually quite evident, and may interfere somewhat with securing the best results. This is a practical point to remember, especially in the repair of complete lacerations, where the inelasticity of the atrophied tissues may prevent exact approximation and good union.

If lactation is greatly prolonged or frequently repeated by rapid childbearing, the atrophy may become permanent and even result in amenorrhea and sterility. Premature genital atrophy is usually due to this cause. Lactating women with tuberculosis are especially prone to permanent atrophy (Küstner).

A third form of atrophy is that due to castration. This form is identical in its physiologic processes with the senile type. It is more marked in women approaching the natural menopause than in younger women. It often takes place very rapidly after the operation of castration, anemia and drying of the external genitals sometimes being noticed within two weeks after the operation.

Pathologic genital atrophy may be the result of constitutional diseases, the most important of which is pulmonary tuberculosis. Other diseases which are said to act in the same way are chronic nephritis, diabetes, morphinism, articular rheumatism, diseases of the spinal cord, cachexia strumapriva, and severe psychic disturbances.

Severe puerperal sepsis of the uterus may cause a loss of uterine wall tissue by necrosis, and thus produce a mechanical form of atrophy (Küstner).

The **etiology** of genital atrophy is referred to suppression of the internal secretion of the ovaries, one of the chief functions of which is to preside over the integrity of the other genital organs. It seems probable that the atrophy is caused by a local anemia of the parts which inevitably ensues as a result of hypofunction of the ovaries.

Genital atrophy, being for the most part a physiologic process, as a rule gives no trouble, but it may under certain conditions produce complications that are of serious clinical significance.

One of the most important of these is the shrinkage of the cervical canal, which may result in a partial or complete atresia. Closure of the canal is especially apt to occur in cervices that long before have been repaired for lacerations.

Complete closure causes sometimes, though not always, a backing up in the uterine canal of the serous secretion of the endometrium and produces a so-called hydrometra. If before complete closure an ascending infection takes place, the contents of the canal become purulent and the condition is then one of pyometra. Usually the atresia of the canal is incomplete, so that the contents are retained only temporarily and are then discharged more or less periodically. This interruption of free drainage from the uterus favors infection and chemical change in the secretions, so that they become very irritating. The periodic discharge from a pyometra may be extremely fetid and simulate the characteristic odor of malignant disease of the cervix. For this reason these cases are very frequently diagnosed as cancer.

The irritating uterine discharge is instrumental in macerating the vaginal epithelium, which is thin and desquamates easily, thus producing a senile vaginitis. The chemical effect of the discharge on the vulva is productive of pruritus, and if sufficiently prolonged may cause permanent changes in the cuticle such as have been described under Kraurosis (*q. v.*).

Senile vaginitis may result from the irritation of retained secretions from the uterus, or it may develop independently as a sequel of senile atrophy. The thin, easily desquamating epithelium is readily macerated by friction and infected by the bacteria that have their habitat in the vagina. A thick, white discharge is produced, usually of a foul odor, the consistency and color of the discharge being due to a great amount of desquamated vaginal epithelium. The destruction of the epidermis is localized in various areas of the vagina, which may appear either as mottled red spots or may sometimes present fissures or ulcers. If the destruction of the epidermis is sufficiently deep, mild hemorrhages are produced, so that the discharge becomes tinged with blood, an appearance that is still further suggestive of cancer.

Senile vaginitis, like that seen in children, has a marked tendency to form plastic adhesions in the vagina. In senile vaginitis, however, the adhesions usually form in the upper part of the vagina, in contrast to those of the infantile type, which form at or below the lower third of the canal.

The vault of the vagina may become intimately attached to the cervix so as to bury it almost completely, or the walls may adhere in such a way as to form a partial or complete atresia of the canal. The process may extend to the vaginal portion of the cervix and seal over the external os, causing conditions similar to those described under constriction and atresia of the cervical canal, namely, hydro- or pyometra.

Genital atrophy causes a shrinking and narrowing of the vaginal introitus, and if there happen to be strands of scar-tissue in the perineum, such as may have resulted from earlier operations, they tend to contract into dense unyielding cords that may be a source of great discomfort in various ways. The patient may be conscious of a tight drawing sensation, which, by incessantly holding her attention, may produce a severe form of genital neurosis.

The tight cord-like obstruction to the vaginal introitus makes coitus painful or impossible, and causes marital unhappiness and sexual neuroses.

The cicatricial perineum may act as a dam to interfere with the free drainage of the vaginal and uterine secretions, with resulting vaginitis and external irritation. The cicatricial perineum is nearly always the later result of an overzealous perineoplasty which has drawn the perineum too tightly at one or more points, so as to create a sharp ridge. Such a perineum may not give much trouble until the natural menopause or until the patient undergoes a pelvic operation involving the removal of the ovaries.

When a perineoplasty is done at the same time as a hysterectomy the perineum, if closed too tightly, may shrink and give trouble soon after the operation.

The practical lesson from these cases impresses the importance of a proper technic in perineoplastic operations. The sharp, cord-like scar formation may result from sepsis and healing by granulation, or it may be due to drawing the wound edges too tightly in consequence of an injudicious denudation. It is to be remembered that the scarring is subcutaneous, and does not reach into the muscular elements, which cannot be approximated too closely. A repaired perineum which presents a smooth funnel-shaped introitus is not likely to give trouble from atrophy. This result can be attained in a perineoplasty, if it be remembered that the real support of the perineum must be sought for in the union of the levator ani muscles and not in the tense approximation of superficial tissues.

Senile atrophy may cause trouble in the vestibule of the vulva. This is shown especially in the effect which the shrinking of the tissues has on the urethra. The urethral mucous membrane may be literally dragged outward by the contraction of the epidermis of the vestibule, forming an eversion or ectropion, a condition that has somewhat the appearance of a urethral caruncle. It usually gives little trouble, but the pouting membrane may become irritated and cause great annoyance. In extreme cases thrombosis and gangrene of the prolapsed mucous membrane may occur, requiring surgical interference.

True caruncles are especially apt to form in women who have genital atrophy.

The general process of atrophy involves also the urethra and bladder. In the urethra a stricture may result, while in the bladder the wall, losing its elasticity, shrinks and causes a diminution in the capacity with consequent frequency and discomfort of micturition.

The most distressing symptom of senile atrophy is that which comes from the vulval epidermis, especially that portion immediately around or just at the introitus. The sensation is one of heat and dryness in some, and in others an intense itching or pruritus. As stated above, it is probably due to the chemical effect of the retarded secretions, though it is sometimes seen where there is no appreciable vaginal discharge. The result is a form of vaginismus that may be a source of great nervous irritation. The constant occupation of the patient's attention on the perineal discomfort with no apparent lesion sometimes leads to

the diagnosis of a pure neurosis. The patients no doubt acquire neurotic habits and overvalue their uncomfortable sensations, but, like other genital neuroses, the nervous irritability has a definite physical basis in continual nagging discomfort.

The **diagnosis** of changes due to senile atrophy is usually simple, the numerous mistakes that are made by practitioners being due to the fact that the disease has not been sufficiently brought to their attention.

The disease for which genital atrophy is most commonly mistaken is cancer. The appearance of a foul, bloody discharge after the menopause is, of course, most suggestive of malignancy. Usually a bimanual examination settles the matter definitely by revealing the smooth vagina, the atrophied cervix, and the small flexible uterus. One should always be on guard, however, not to miss the inverting form of cancer of the endocervix, which in the early stages may not be apparent to touch or sight. In the same way adenocarcinoma of the body may, and often does, originate in an atrophied uterus. In all cases, therefore, where there is a suspicion of cancer an intra-uterine examination should be made with the curet under an anesthetic. Such an examination is important also in determining and treating, if present, atresia of the cervical canal.

In determining the underlying cause of pruritus and kraurosis it is all important to search for possible obstructions of the secretions in the vagina and cervix.

Ulcers and fissures of the atrophied vaginal membrane may resemble malignant disease. The diagnosis, on the least suspicion, should be made by microscopic examination of an excised specimen of tissue.

**Treatment.**—In treating the complications due to genital atrophy it should be a routine measure to anesthetize the patient and explore the uterine canal, partly with the purpose of ruling out cancer and partly with the purpose of finding and dilating possible strictures of the canal. These strictures occur much more commonly than is supposed. Though they may not constitute a complete atresia, yet they may interfere with good drainage. If an unsuspected cervical stricture does exist, treatment of the vagina and vulva may go on indefinitely without doing the least good.

As a rule, dilatation of the cervical canal is enough. If the stricture or atresia is near or at the external os an artificial bilateral laceration may be made in the cervix, so as to give the canal a tube-shaped outlet.

If pyometra is present the dilatation may be followed by a recurrence of the old process. If this happens a hysterectomy is indicated.

If there is a vaginitis it is necessary first to determine whether the inflammation is caused by retarded secretions, and, if this is so, to perform such an operation as may secure good drainage. The local treatment of the vaginitis itself is best carried out by the application of iodin, to which the condition readily yields.

The cicatricial perineum must be treated by a plastic operation, in which

the scar-tissue is carefully dissected out. It is best to make a transverse incision at the middle line, and to carry out the dissection with scissors *subcutaneously* on each side. This avoids the removal of any epithelial tissue. The wound is sewed up in the opposite direction of the incision. In this way a funnel-shaped opening is given to the introitus, through which the vaginal secretions can now easily drain (see page 694).

The wound from this operation must be sewed up with great care as to approximation, otherwise there is more than ordinary danger of sepsis and healing by granulation, which may result in a new scar similar to that which was dissected out.

Treatment of the vulva depends chiefly on securing proper vaginal drainage. If permanent changes have taken place in the cutis, ovarian extract is indicated, and is sometimes followed by very satisfactory results.

Ectropion of the urethral mucous membrane is best treated by plastic excision, while caruncles may be removed either by operation or by the use of the high-frequency current. This last method of treatment is especially valuable in the recurrent type of caruncle (*q. v.*).

Irritability of the urethra due to stricture yields readily to dilatation. Irritability due to local inflammation of the urethral or vesical mucous membrane is exceedingly pertinacious and difficult to cure. It is referred to in greater detail on page 281.

## UTERINE INSUFFICIENCY

This is a somewhat vague term, used to designate a uterine condition in which there is severe menorrhagia without any apparent well-defined anatomic cause for the abnormal bleeding. Various names have been applied to this condition, but "uterine insufficiency" describes it best, in that it implies an inability of the uterine musculature to terminate properly the menstrual flow of blood. We meet with uterine insufficiency most commonly in women approaching the menopause, though it sometimes occurs in comparatively young women. It may be so severe and persistent as to be regarded as a definite disease, or it may occur as a temporary condition, as sometimes happens, for example, during the establishment of the menopause.

With regard to the etiology and pathology of uterine insufficiency we are very much in the dark. It was formerly quite generally supposed to be the result of a premature arteriosclerosis of the uterine blood-vessels, but this view has little acceptance at the present time. One investigator (Theilhaber) has advanced the interesting theory that the inability of the uterine musculature to functionate properly is due to a disproportion of connective tissue over muscular tissue in the myometrium. He showed that as the menopause is approached there is a progressive diminution of the muscular fibers of the myometrium, with a corresponding increase of connective tissue. This change may be increased by successive pregnancies. If the increase of muscle over connective

tissue is abnormal the uterine wall may lose its contractile power to such an extent that it becomes insufficient to control the menstrual flux. The theory is logical, and probably explains to some extent the menorrhagias seen near the menopause. It is, however, not entirely borne out by experimental evidence (Schickele).

More recent theories explain uterine insufficiency on the ground of some aberration of the ovarian secretions. A discussion of this subject is found on page 45.

**Symptoms.**—The chief symptom of uterine insufficiency is excessive or prolonged menstruation, usually with a shortened intermenstrual period. The blood is often clotted. Secondary symptoms resulting from anemia and exhaustion may be varied and numerous. Prominent among these are nervous disturbances, which are due partly to the constitutional drain from loss of blood and partly to mental apprehension.

**Diagnosis.**—In order to make a diagnosis of uterine insufficiency it is necessary to rule out absolutely all other conditions which simulate it. These are most commonly abnormal gland hypertrophy of the endometrium, cervical or endometrial polyps, uterine myomata, and cancer either of the body or cervix. Such a diagnosis, as a rule, should be made under an anesthetic, so that a careful intra-uterine examination with the curet and placenta forceps may be carried out. If the cervix is at all doubtful, a piece is removed. The specimens of endometrial and cervical tissues are placed at once in formalin or alcohol and examined by a competent pathologist. By the examination under an anesthetic small fibroids may be more easily detected; if the condition is due to a gland hypertrophy or an endometrial polyp, the removal of tissue may serve as a curative measure; while if cancer is present the patient's life may be saved by a timely radical operation.

If the above-mentioned conditions can be ruled out, we are then justified in making a diagnosis of uterine insufficiency. The uterus may be misplaced, and it may be larger and softer than normal. On the other hand, it is sometimes perfectly normal in size and consistency.

The **treatment** of these cases is either palliative or radical. Palliative measures are usually to be tried first if there is no doubt about the diagnosis, as uterine insufficiency is not a fatal disease and time may be taken in its treatment.

Cureting, as a rule, does little more than temporary good, if it does that. The usual drugs, such as ergot, hydrastis, hamamelis, etc., are practically useless. Pituitrin is reported to be of some value, but seems to be less efficacious than in the functional menorrhagias of youth.

Vaporization is sometimes used in the treatment of the so-called hemorrhagic metropathies, of which uterine insufficiency is the most conspicuous example. The method employed by Fuchs is as follows: The uterine cavity is first thoroughly cureted. An insulating tube is then introduced to protect the isthmus. Steam is applied to the cavity of the uterus at a tempera-

ture of 115° to 120° F. for from thirty to sixty seconds. This method is especially applicable to uterine insufficiency of the preclimacterium, but is contra-indicated in all inflammatory conditions either of the uterus or of the myometrium. Fuchs claims a cure of 92 per cent. in the treatment of 71 cases.

We have had no experience with this method.

The most efficacious treatment for uterine insufficiency is by the use of radium. A full discussion of the treatment is given in the section on Radium Therapy in Non-malignant Conditions (*q. v.*).

Many times it is necessary to resort to operative measures. If the uterus is retroflexed and congested an operation for replacing it may relieve or cure the symptoms, but this result is by no means to be guaranteed, and the patient should understand this before the operation is performed. If palliative measures fail, and the patient is near the menopause, supravaginal hysterectomy may be resorted to with a practically sure prospect for cure. The results of the operation are especially good in restoring the patient to a normal equilibrium when there has been a nervous element in the symptomatology. A decision for the operation of hysterectomy in uterine insufficiency is governed by much the same factors as those considered in the Treatment of Chronic Pelvic Inflammation (see page 218).

Dr. Howard A. Kelly has recommended an operation which he calls "hysterotomy." This consists in removing the endometrium by taking out a wedge from the center of the uterine body. It is doubtful if the results of this operation make it preferable to hysterectomy, except in special cases based on sentimental considerations.

## INFANTILISM AND STERILITY[1]

The term "sterility" is somewhat difficult of precise scientific definition. It is not enough to say that sterility implies an inability to conceive, for it may be that by the removal of certain obstacles the individual may become perfectly capable of impregnation. It is necessary to understand, therefore, that the word sterility may be used in a variety of senses, for which a number of modifying terms have been suggested. Absolute sterility is a condition where impregnation is obviously impossible, as in certain cases of defective uterus or ovaries, or in congenital absence of vagina. The expressions "primary" and "secondary sterility" are frequently used. Primary sterility denotes that the individual does not conceive under normal conditions during the first few years of married life, arbitrary times being set by different observers, as three years (Kisch) and five years (Torkel and E. Fränkel). Secondary or acquired sterility is used to describe the individual who though at first fruitful or capable of child-bearing, later becomes incapable of fertilization.

[1] The material in this section is taken from an article by the author published in the Transactions of the American Gynecological Society of 1913.

**Etiology.**—The causes of sterility may be divided broadly into those that are idiopathic and those that are acquired. The chief idiopathic causes of sterility are fetalism and infantilism of the genital organs. *Fetalism*, a term introduced by Alfred Hegar, relates to a faulty or arrested development that takes place in intra-uterine life, and is represented by the various forms of uterus didelphys or the failure of the union of the Müllerian ducts, and by conditions of aplasia, such as absence of the vagina, uterus, ovaries, or tubes. In most cases of fetalism impregnation is obviously impossible, and therapeutic or surgical measures for producing fertility are entirely out of the question. *Infantilism*, on the other hand, as the term will be used, presupposes that the individual has been born with a full equipment of genital organs, without mechanical obstruction to fetation, but that during childhood an arrest in development takes place, so that in the child-bearing age the organs retain certain characteristics of the prepubescent period. Infantilism of the genitals may occur as the only stigma of defective development, and the individual may be otherwise perfectly and even exceptionally developed; or the genital infantilism may constitute only an incident in a general hypoplasia manifested in other parts of the body. We see, therefore, two characteristic types of sterile women—one the large, full-blooded, often powerful-looking individual, with tendency to fat accumulation, and the other the meager, unripe old-maid type. In the woman of the first class there is usually nothing in the external appearances to suggest a genital hypoplasia, while the individual of the latter class exhibits numerous easily recognizable characteristics. Among the familiar marks of the old-maid type of woman are the long, thin, unbeautiful neck; the long, small thorax; the weak flat back, with its spinal curvature, winged scapulæ, and lack of muscular development; the flat pelvis, the poor development of the glutei muscles; the narrow hips and slender thighs, and the underdeveloped or thin pendulous breasts. In both these classes of women the nervous system is extremely sensitive and the nervous equilibrium unstable. In both there is usually some menstrual disturbances, most commonly in the form of severe dysmenorrhea, which is an important factor in the nervous symptomatology.

The external genitals may or may not be fully developed, but in the old-maid type of woman they are often meager, the labia minora being pale and thin, and the labia majora flat and ill formed. In such cases the musculature of the perineum is often defective, and occasionally vaginal prolapse or procidentia of the uterus occurs.

**Causes of Infantilism.**—The causes of infantilism are somewhat problematic. It would seem as if hereditary and early environmental influences might be important factors. There is no doubt that syphilis, alcoholism, epilepsy, and insanity of ancestors, as well as race degeneration from incest or consanguinity, are responsible for a certain amount of infantilism in the offspring. Premature birth, poor nourishment during infancy, early diseases, such as rickets, tuberculosis, chlorosis, etc., are often found in the histories of hypoplastic individuals.

Many cases show congenital defects in the circulatory and respiratory organs, such as small hearts, narrow and thin-walled vessels, and long, narrow chest walls, with insufficient lung capacity, though these defects are often regarded not so much a cause of the genital infantilism as a manifestation of a general constitutional hypoplasia, in which the genital defects incidentally take part.

It is necessary to take into consideration the possible relationship of the other glands of internal secretion, such as the adrenals, the thyroid, the hypophysis, and the thymus. It is well known that these organs all have an intimate relationship with the organs of generation, and that mild disturbances of the harmony between these related organs of internal secretion may interfere with the most important function of the ovary and its germ-cells. Diseases of the various organs of internal secretion are usually attended with genital atrophy or infantilism and sterility. Patients suffering from hypophyseal diseases, such as acromegaly and giantism, or hypopituitarism, are amenorrheic and sterile. Patients with myxedema are usually sterile and have deficient genitalia, while Graves' disease is often attended with sterility and functional disturbances of menstruation. The same is true of Addison's disease. This branch of the subject of sterility is comparatively new, but the knowledge which is rapidly being acquired of the physiology and chemistry of the organs of internal secretion gives great promise of shedding light on a class of cases which has hitherto been completely baffling.

The question of the influence of the internal glandular secretions on the development of the genitalia is treated in a separate section (Part I).

It is an interesting query why infantilism is more common in women than it is in men. It may be said that the sexual apparatus of woman is so much more complicated than that of man that the chances of local hypoplasia are very much increased. Hans Bab says, "In general habit, in constitution, and in general mentality woman is half-way between man and child, and hence a certain amount of infantilism may be regarded as physiolcgic." There is unquestionable biologic basis for this theory.

In considering the causes of sterility from infantilism it is necessary to realize that there is a wide field of possibilities, any one of which may conceivably be sufficient to prevent impregnation. These various abnormalities may occur in any part of the internal or external genitals, and it is important to discuss them in detail.

*Ovaries.*—The ovaries of women who are sterile on account of infantilism may be entirely normal, or they may present certain characteristics typical of the hypoplastic condition. In somewhat rare instances there is an incomplete descent of the ovary, which may be retained in a position at or even above the brim of the pelvis. It is usually associated with a short appendiculo-ovarian ligament, which may have the effect of retroverting the uterus. Non-descent of the ovary, however, is not to be regarded as a common cause of sterility, and

whenever it occurs there are usually other stigmata of developmental defect sufficient to prevent fetation.

The ovaries in infantilism often present certain characteristics that may be of special significance. They may be very small, often not larger than a hazelnut. The contour instead of being oval is often elongated or spindle shaped, while in other instances the ovary, while retaining its normal contour, is markedly flattened.

Another characteristic frequently seen in infantile ovaries is the dense whiteness and smoothness of the surface. This is due to a marked thickening of the albuginea or connective-tissue cortex of the organ. Many times the ovaries of infantilism are larger than normal, due to the tendency to atretic follicle formation.

If these hypoplastic ovaries be examined microscopically it will often be found that most of the follicles have not developed beyond the primordial state, and that there is a marked increase in connective tissue, as manifested by the thickened albuginea. According to Kehrer, this lack of development of the follicle apparatus accounts for the defective function of the ovaries on the ground of the late onset of menstruation, the frequency of amenorrhea and dysmenorrhea, of sterility and failure of sexual impulse, vicarious menstruation, etc.

Very theoretic is the explanation of ovarian deficiency on what might be called mechanical grounds, by which an attempt is made to show that the proper ripening and bursting of the follicle is prevented either by too great external resistance or by insufficient internal pressure.

Ovaries vary greatly in size and in the number of follicles in different individuals, and even in the same individual. According to Waldeyer and Heyse, the average total number of follicles amounts to about 35,000. Only about 400 of these follicles ripen during the thirty years of menstrual life, hence most of them become atretic, with the consequent death of the ovum and the granulosa epithelium. According to Strassman, this follicle-atresia represents a rudimentary state of development and takes place not only in young childhood but even in fetal life. Certain it is that it is very characteristic of the ovaries of hypoplastic genitalia, in which the follicle atresia seems to take the place partially or completely of the normal ripening and bursting. The cause of this is uncertain, but may be explained theoretically with a certain amount of reason. The complicated process of ripening and bursting of a normal mature follicle presupposes rather a delicate balance between the internal pressure of the follicle and the resisting power of the surrounding envelope of the ovary. As has been pointed out, the ovaries of sterile women often show an albuginea (or connective-tissue cortex) which is thicker and denser than normal. It is also seen that the cells of the germinal epithelium in infantile ovaries are higher and larger than those of the normal ovary. Hence it is conceivable that the follicle meets with too great a resistance to reach full maturity and discharge of the ovum. It is possible, too, as Hans Bab suggests, that the internal pressure of the follicle may be

deficient on account of incomplete congestion, as is manifested by the scanty or infrequent menstruation which often characterizes these cases. It is not uncommon to find no traces whatever of corpus luteum formation in these ovaries.

*Tubes.*—Although we know that the tubes play a most important rôle in the acquired sterility that results from gonorrhea and tuberculosis, we do not always realize that they, too, may take part in the genital hypoplasia and be the means of preventing conception. Some of the theories regarding infantilism of the tubes are worthy of note. W. A. Freund, to whom we are indebted for the foundation of our present knowledge of the subject of infantilism, called attention to the fact that at birth the tubes are markedly twisted in a spiral form, especially at the uterine ends. We are familiar with this appearance in cases of chronic salpingitis, and it was at first objected that what Freund had interpreted as a congenital twisting was, in fact, the result of a fetal pelvic inflammation. This abnormality has been found so commonly, however, in cases of genital hypoplasia that it is now regarded as a stigma of infantilism, and it is thought that it may in some way prevent conception. It is supposed also that this congenital twisting of the tube may account for those unexplained cases of extra-uterine pregnancy which occasionally occur in women who have long been sterile.

Bumm has called attention to the fact that the development of the fimbriated end of the tube may be of great importance in receiving the egg on its passage from the ovary, and shows how in normal cases the fimbriæ exhibit a beautifully delicate and profuse structure, while in others it is scanty and meager. When one considers the frequency with which impregnation takes place after resection of the tubes, it must be admitted that the presence of the fimbriæ is not necessarily essential to impregnation, though it is probable that defective development of them acts as a partial preventive of conception.

Other structures of the tube which may be affected by infantilism are the musculature, the labyrinth, and the cilia. The arrangement of the muscular structure of the tubes makes it probable that a peristaltic action takes place which is important in passing on the germ-cells, and that incomplete action due to congenital weakness may result in sterility or extra-uterine pregnancy. The labyrinth and the cilia are of very great importance in a sterility which is due to inflammatory processes, and there is no reason to doubt that an incomplete development of these delicate structures of the tube may also have a considerable influence in preventing fertility.

*Uterus.*—In making a diagnosis of genital infantilism one is very largely guided by the examination of the uterus, and it is to this organ that surgical or manipulative treatment is usually directed. There is no doubt that developmental abnormalities in the position of the uterus often cause sterility, as is proved by the frequency with which the condition is cured by surgical correction.

The infantile uterus is the keynote to genital hypoplasia and is easily recog-

nizable. It may appear in two forms. In the first the entire uterus, normal in its proportions of the body and neck, is simply a miniature of the fully developed organ, and is termed a "pubescent" or "dwarf" uterus. In the second, and far more common form, there is a disproportion between the body and neck. Whereas normally the body of the uterus is about 7 cm. long and the cervix 3 cm., in the infantile uterus the conditions are reversed, the cervix being longer than the body. There is usually also an abnormal relationship in position between the body and the neck in the form of a sharp anteflexion or retroflexion. The long cervix is slender and conical and *points in the axis* of the vagina, whether the body be ante- or retroflexed. If there is no abnormal flexion, and the body is in position, the cervix points in the proper direction, but is so long that it impinges on the posterior wall of the vagina and gives one the impression of being far back in the sacrum.

Of the conditions of retroflexion and anteflexion, that of anteflexion is much more common, and occurs so frequently that a diagnosis of its presence can often be made from the history of dysmenorrhea and sterility with which it is usually associated.

Do developmental flexions of the uterus cause sterility? Up to the present time no very satisfactory answer to this question has been evolved. It is inconceivable that the bend in the uterus should act as an actual mechanical obstruction to the passage of the spermatozoön by narrowing the canal. In most cases the canal is dilated with great ease, the only difficulty being in those instances where a cicatricial band forms near the point of flexion. The old-time theory of obstruction is explained away by the observations of uteri in swine, sheep, and dogs, in which the sharpest physiologic flexions cause no hindrance to the spermatozoa.

There is little doubt that the abnormal relationship that exists between the cervix and vagina in all cases of forward or backward flexion has an important influence in preventing sterility. We have seen that the cervix points in the direction of the long axis of the vagina instead of at right angles to it. It would at first seem as if the former were a more favorable position for the reception of the spermatozoön after ejaculation, and, in fact, anatomists not so very long ago believed it to be the normal position of the cervix. It has been pointed out, however, that the pouch which lies behind the vaginal portion of the cervix plays an important part in the retention of the semen, and has aptly been termed by Biegel the *receptaculum seminis*. Under normal anatomic conditions the cervix points directly into this receptacle, and after coition dips into the pool of semen there retained. In this way the passage of the spermatozoa into the cervical canal is greatly favored. In nearly all cases of hypoplasia this proper relationship between cervix and vagina is disturbed. If the uterus is flexed either forward or backward the cervix points directly away from the receptaculum. When there is no flexion the cervix is often so long that it impinges strongly against the posterior wall and the receptaculum is obliterated. Ab-

normal shortness of the vaginal wall may bring about like conditions, for if the anterior wall is too short the cervix is pulled forward, and if the posterior wall is too short the receptaculum is obliterated.

It has been mentioned above that in many cases of flexion due to hypoplasia there exists a cicatricial band in the cervical canal corresponding to the point of angulation, usually at the level of the internal os. This band offers a distinct resistance to the passage of sound or dilator, and gives an impression similar to that given by a urethral stricture. Bumm has styled this condition "callous stenosis" of the cervix, and is of the opinion that it is an important factor in the prevention of conception. The origin of this cicatricial band is not known. Whether it is a result of the long-standing flexion, or whether it existed primarily and was instrumental in causing the flexion, is a matter of speculation. The existence of abnormal connective tissue in the infantile uterus is not surprising in view of the fact that in the uterus before puberty there is a preponderant proportion of connective tissue to musculature (Theilhaber).

It is also a matter of speculation as to how this cicatricial band serves to prevent conception. It may alter the reaction of the cervical secretions by interference with its circulation, or it may favor the formation of a cervical mucous plug which obstructs the entrance of spermatozoa. Moreover, it is observed that when this callous stenosis is present the cervix has a tendency to be stiff and unyielding. Sims many years ago called attention to the fact that the structure of the cervix, as well as its form and position, is of much significance for the reception of the spermatozoön, and there is no doubt that a cervix lacking in normal mobility is unfavorable to fertility. This is especially important, in view of the fact that the normal cervix has to a certain extent the function of aspirating the semen from the vagina (Rohleder). E. Fränkel has pointed out that the prognosis for the cure of sterility where callous stenosis is present is especially bad.

The term "effluvium seminis" is used to describe the escape of semen from the vagina following coitus, and is thought by some to be an important cause of sterility. This condition may be brought about by lacerations and prolapse of the vaginal walls from childbirth, but it may also be the result of hypoplastic defects in the vaginal wall. Bumm has repeatedly shown in cases of short anterior vaginal wall the absence of spermatozoa in the vaginal or cervical secretion shortly after coitus. It is said that some women have the power of voluntarily pressing out the semen and thus preventing conception for long periods of time. Bumm says: "Although only one spermatozoön is necessary for fertilization, nevertheless there is little chance of a meeting of the egg and this one, if out of the millions of spermatozoa deposited at each coition at least thousands do not reach the internal genitalia."

Natanson and Konigstein have investigated the significance of the escape of semen from the vagina as a cause of sterility in 26 sterile women who complained of this complication. They examined the uterine and vaginal secretions for spermatozoa from three to sixty hours

post coitum. Of the 26 cases, 13 had uterine misplacements, 11 were hypoplastic, and 2 had cervical catarrh without anatomic changes of the uterus. Twenty-two of the women had primary, and 4 had secondary, sterility. In 38.5 per cent. spermatozoa were not found in the uterus, and in some of these they were not found in the vagina. Hence it is likely that the man was at fault in some of these cases. Spermatozoa were found in the uterine and vaginal secretions in 6 out of the 13 misplacement cases, in 9 out of the 11 hypoplastic cases, and in 1 of the cervical catarrh cases. Inasmuch as spermatozoa were found in large numbers in the uterine secretions of 61.6 per cent. of these cases, the writers conclude that the symptom of effluvium seminis cannot be regarded as an adequate cause for sterility.

Although effluvium seminis may prevent conception to a certain extent, its effect must be only relative, as is proved by the frequency with which impregnation takes place without introition.

**Causes of Acquired Sterility.**—*Gonorrhea.*—Of the acquired causes of sterility, gonorrhea is by far the most important, especially when one considers the blighting effect the disease has on the procreative powers of man as well as of woman.

In woman gonorrhea most commonly prevents fertility by sealing the ends of the Fallopian tubes, or by so injuring the mucous membrane of the tubes as to destroy their function as oviducts. This injury consists in a gluing together of the tips of the delicate rugæ of the tubal mucous membrane, so that the germ-cell, instead of finding a free passage through the tube, encounters a labyrinth of blind pockets. It is probable, too, that in this process there is a more or less permanent destruction of the cilia which clothe the tubal epithelium and which are thought to aid in the transference of the germ-cell.

Gonorrheal infection of the adnexa has been differently estimated as the cause of sterility in women in proportions varying from 8 to 59 per cent. Sänger's figures, showing 33 per cent., are probably near the truth.

Gonorrhea limits fertility also by infection of the cervical mucous membrane, chronic endocervicitis being a frequent cause for primary sterility. This condition is, however, less serious than when the adnexa are involved. Endocervicitis may also be the cause of secondary sterility, for it not infrequently happens that a gonorrhea of the cervix acquired after impregnation ascends to the tubes postpartum, and thus causes a permanent secondary sterility. This process is the chief factor in one-child sterility. The part played by man in sterile marriages has of late received much attention, and he has been found at fault in a far greater number of cases than was formerly supposed. The cause of sterility in man outside of impotency is commonly due to gonorrheal disease of the epididymis, vasa deferentia, or the seminal vesicles. The conditions found are azoöspermia, due to occlusion of the vasa deferentia from a double epididymitis; necrospermia, in which the spermatozoa are killed on account of pathologic changes in the seminal vesicles and prostate; aspermatism, due to stricture. Lier and Asher found that 70 per cent. of sterility in man is due to gonorrheal changes, and in comparing the relative responsibility of man and woman in sterile marriages they estimated that of man at about 40 per cent. and that of woman at about 60 per cent. The actual moral responsibility of man,

however, is considerably greater than appears in these figures, because a very large percentage of the gonorrhea in married women has been transmitted from husband to wife.

*Puerperal Sepsis.*—It is very difficult to compare the effects of gonorrheal infections with those of puerperal sepsis. Puerperal sepsis is itself frequently the result of gonorrheal infection, so that in such cases the cause and effect are essentially gonorrheal. Where the infection is entirely puerperal it is probable that permanent damage is less than that wrought by gonorrhea. Puerperal infections are more apt to invade the pelvis through the lymph-channels of the uterus and parametrium. Thus it is that the tubes are attacked from the outside. Even when puerperal sepsis passes into the tubes through the uterine ostia there is far less damage to the tubal mucosa than in gonorrheal salpingitis. Microscopically, the pus is seen to be lying on the surface instead of invading the submucosa. There is not the plastic exudation and gluing of the rugæ that is seen in gonorrheal salpingitis, and it is possible thus sometimes to make a microscopic diagnosis between the two forms of infection.

*Endocervicitis* not gonorrheal in origin is a condition to be reckoned with in treating sterility, and one which is more readily susceptible of cure than are most of the other causes. It is manifested by a hypersecretion of the glands of the cervical mucous membrane, so that the cervix is filled continually with a thick plug of mucus which acts as a complete mechanical obstruction to the passage of the spermatozoön. In some cases the reaction of the cervical secretion, which is normally alkaline, becomes acid, and hence becomes a medium in which it is impossible for the sperm cell to live.

This form of endocervicitis may be due to ectropion and irritation of the cervical mucous membrane following laceration of the cervix, under which circumstances, according to Schauta, it may be a sufficient cause for sterility. On the other hand, it is often seen in nulliparous uteri even in virgins. It is often associated with hypoplastic uteri, in which case it may be induced by a callous stenosis of the internal os.

That this mucous hypersecretion is a definite etiologic factor in sterility is entirely proved by the frequency with which a simple removal of the plug by a cureting or local treatment of the cervix is followed by fertility.

*Endometritis.*—When we come to infections of the endometrium with reference to sterility it must be admitted that our knowledge is very vague. We read much in the text-books of the symptoms and treatment of acute gonorrheal endometritis and the baleful results of chronic endometritis as a result of the same disease. Nevertheless, we find infrequent microscopic evidence of true endometritis, acute or chronic, even in cases of active gonorrhea of the adnexa. It is evident that the gonococcus has little liking for the endometrium, and passes to the more congenial tubal mucous membrane as rapidly as possible. Infectious endometritis, both acute and chronic, is much more commonly the result of puerperal sepsis. It is doubtful if endometritis from any cause (ex-

cepting possibly tuberculosis) plays an important part in preventing conception, though it is probable that the chronic interstitial endometritis that occasionally follows puerperal or gonorrheal sepsis may encourage spontaneous abortion by offering a poor soil for the nourishment of the ovum.

*Genital tuberculosis* is nearly always attended with sterility. The tubes become involved in adhesions and become closed in the same way as in a gonorrheal infection. If the endosalpinx is involved, the disease entirely obliterates the tubal canal and frequently invades the endometrium and myometrium from above. Early genital tuberculosis often causes complete amenorrhea.

*Cystic Degeneration.*—Kossman thinks that small cystic degeneration of the ovaries causes sterility. It is not likely that cystic degeneration is itself a cause of sterility, but rather merely an associated condition. We have already seen how it may be the result either of too great resistance on the part of the albuginea or of a deficient internal pressure in cases of hypoplasia. Cystic degeneration is also common in pelvic inflammatory cases, but it is undoubtedly of entirely secondary importance as regards sterility. As a result of the investigations of Schiekele and others cystic degeneration of the ovaries is no longer regarded as an essential disease.

*Acquired Misplacements of the Uterus.*—It has already been pointed out that congenital or developmental misplacement may be an important factor in sterility. Acquired malposition may also prevent or limit fertility. There is no doubt that women with acquired retroversion-flexion are in a large percentage of cases sterile. That the malposition of the uterus is the cause of the sterility is shown sufficiently well by the frequency with which these patients become pregnant after restoration of the uterus to its normal position. In acquired retroversion conception is probably prevented in the same way as in hypoplastic malpositions, not by mechanical obstruction, but by the dislocation of the cervix, by which it no longer properly dips into the receptaculum seminis.

Relaxation of the vaginal walls is sometimes regarded as a cause of sterility. It is doubtful, however, if this cause is a frequent one, for it is surprising occasionally to find women pregnant who have very marked prolapse, sometimes amounting to a complete procidentia. If relaxation of the vagina does prevent conception, it is possible that it is due to the inability of the semen to remain in the vagina, with consequent effluvium.

*Tumors.*—The relation of tumors to conception may be important. Tumors of the external genitals, like cysts of Bartholin's glands, vaginal cysts, fibromas of the vulva or vagina, advanced carcinoma or sarcoma of the cervix or vagina, may prevent proper coition. Carcinoma in the early stages does not necessarily cause sterility, for instances of cancer associated with pregnancy are occasionally observed, and would be seen oftener if cancer did not usually occur later than the child-bearing period.

Women with double ovarian tumors are usually sterile, but unilateral cysts are no prevention to conception. Women with dermoid cysts of the ovary

are frequently sterile, but they are very apt to have stigmata of hypoplasia in other parts of the genital apparatus.

The relationship of uterine myomas to sterility is a subject that has created a great amount of speculation and argument. That fibroids should act as a hindrance to fertility is not surprising when one considers the frequent complication of diseased adnexa, the deformities of the uterine canal, the atrophic and hypertrophic changes in the endometrium, the profuse menstruation, and other abnormal conditions which the presence of myomas may bring about. These are obvious mechanical hindrances to impregnation, and might readily act to cause a secondary sterility.

This explanation, however, does not account for the primary sterility which it is claimed characterizes many myomatous women before the fibroids grow to a size sufficient to act as a mechanical hindrance to conception. Some authors believe that there is an inherent constitutional cause for the limited fertility of the fibroid uterus. Abraham Froell says in his work on the subject, "There exists an unknown connection between the physiologic functions of the uterus and myoma formation. Myomatous women have menstruated at an earlier age than the average, and, conversely, girls who begin to menstruate early are more likely than others to develop myomas in later life. A late menopause is the rule in women who have myomas." The author is of the opinion that the myomatous constitution limits and, in some instances, prohibits fertility.

*Perforating Hemorrhagic (Chocolate) Cysts.*—The majority of women suffering from this disease are sterile. Of 15 married women reported by Sampson in his first article, 9 had never been pregnant. Of the 6 who had borne children, only 3 had had more than one. He says, "It would seem that this condition is likely to occur in women who were sterile; or if they had borne children there was a subsequent history of sterility."

*Irradiation.*—The influence of irradiation on fertility is a matter of considerable importance at the present day, especially in view of its employment in the treatment of uterine myomas, which in some quarters is being so urgently recommended. There is no doubt that irradiation permanently destroys the follicles of the ovary. M. Fränkel has shown that the ovaries of women who have been treated by irradiation show marked atrophy of the Graafian and ripening follicles as well as a scarcity of primordial follicles

Reifferschied has shown by animal experimentation that there is no possible regeneration of a follicle that has been injured by the nfluence of irradiation. He also found that the epithelium of the oviducts undergoes severe injury when exposed to the rays. From these observations and from those of many others it is established that irradiation may render an individual completly and irreparably sterile.

It has been noticed by some observers that in certain cases following pelvic treatment by the rays there is a temporary period of amenorrhea, followed in several months by a re-establishment of the normal menses. This is explained

by the fact that irradiation treatment is given only long enough to destroy the riper follicles, and that it is not continued a sufficient length of time to injure the primordial follicles, which are somewhat more resistant to the ray. In the course of time these follicles develop and ripen, with consequent resumption of the menses. It is, however, possible with sufficient dosage to injure all the follicles, and thus completely to destroy the function of the ovaries.

*Miscellaneous Causes.*—Under the wasting influence of some diseases the uterus may undergo certain atrophic changes and thus become sterile. The constitutional diseases which may induce sterility are chlorosis, tuberculosis, diabetes, leukemia, Graves' disease, Addison's disease, nephritis, etc. Of these, tuberculosis of the lungs and Graves' disease most commonly cause trophic changes in the genitalia.

Diseases of the hypophysis exert a very distinct influence on the genitalia, with atrophy of the ovaries, amenorrhea, sterility, and lack of secondary sexual characters. Mention is made elsewhere of the relationship between hypophyseal disease and the pelvic organs.

Changes in the germ-cells of the ovaries with consequent sterility are said to take place in the chronic poisoning of morphin, arsenic, alcohol, phosphorus, and lead. Leppich, in the study of 100 alcoholics, found 28.3 per cent. of them unfruitful.

There is a certain relationship between adiposity and hypoplasia of the sexual organs. It is commonly supposed that adiposity tends to follow badly functionating sexual glands, as in amenorrheic girls, castrated individuals, and women at the climacteric, though in the last-named cases the idea has been greatly exaggerated. Conditions described as infantilism, hypopituitarism, eunuchoidism, hypothyroidism, disgenitalism, dystrophia adiposogenitalis, etc., are all frequently attended by fat deposit and sexual underdevelopment. Conversely, it is stated by Kirsch, Müller, and Horrocks that overnourished women show diminished fertility. This, however, is not a constant rule, for occasionally fat women are extremely fertile. One writer observes that whereas in thin women 1 out of every 10 is sterile, in fat women an average of 4 out of 10 do not conceive. It seems very doubtful if the ordinary acquisition of fat in a woman whose genitalia are sound would limit her fertility. It is possible that where fat deposit and sterility are found associated the fat is a manifestation of an ovarian deficiency.

The protective sterility which women normally undergo during lactation occasionally becomes permanent. During lactation the uterus and ovaries become actually atrophied and cease to functionate. Cases have been reported where on account of overlactation the uterus has become permanently atrophied. This doubtless accounts for the premature senile atrophy of the external genitalia that one occasionally sees in women of the poorer classes who have been fertile earlier in life.

Cases have been reported of permanent atrophy of the uterus and amenorrhea after an overzealous cureting operation.

After all has been said concerning the pathology of sterility, there remains a very large percentage of marital fruitlessness which is referable to the Malthusian doctrine and is the result of preventive measures. Engelman, in a study of social conditions in the United States, estimated that only 12 per cent. of apparent sterility is due to disease. He found that in the beginning of the nineteenth century in this country the average birth-rate for each marriage was 5 children, while at the end of the century it was between 1 and 2. Absence of orgasm and libido-sexualis plays a certain part in sterility. Although some women who experience neither of these sensations are fertile, nevertheless frigidity is especially common in sterile individuals. Matthews Duncan, in an examination of 191 sterile women, found that 39 were without libido and 62 did not experience orgasm. Kisch, in an examination of 69 sterile women, found that 26 derived no pleasure from coitus. Neumann finds that in most women who lack sexual sensibility some hypodevelopment or pathologic disturbance of the genital organs can be found.

Vaginismus is an occasional cause of sterility.

There are some cases where sterility cannot be accounted for by any physical defect on the part of either husband or wife. In cases of this kind Mayerhofer has advanced the interesting theory that the penetrative power of the spermatozoa of a given individual may be greater with some women than it is with others. The most famous example of this theory is that of Napoleon and the Empress Josephine. Josephine had two children by her first marriage. The marriage with Napoleon was fruitless, but Napoleon in his second marriage with Marie Louise had a son, the Herzog von Reichstadt.

The experiments of Reynolds and Macomber seem to show that in individuals otherwise normal nutrition bears an important relationship to fertility. With experimental rats they are able to establish with considerable accuracy a fertility index. In order to secure successful mating the product of the indices of the two partners must reach a certain standard. Thus two individuals of a low fertility index may be sterile, but when paired with mates of sufficiently high fertility, young may be produced. (See article by Reynolds and Macomber, Amer. Jour. of Obst. and Gynec., 1921.)

Consanguinity limits fertility. According to the figures of Gölherts, from 32 to 33 per cent. of consanguineous marriages are sterile, as against the average sterility of 8 to 15 per cent.

The mingling of individuals of certain widely different races leads in several generations to sterility. Examples of this are the octoroons, who represent the repeated mingling in three generations of whites and negroes, and the Lipplapps of Java, who represent in the same way the union of the Dutch and the Malays. This is an illustration of race degeneration. It has been supposed that octoroons are absolutely sterile, but this is not entirely true.

**Treatment of Sterility.**—*Acquired Malposition.*—Much of the reconstructive surgery for sterility is directed to cases of malposition of the uterus.

It may be said in this connection that where sterility is due to a uterine displacement which is the result of childbirth or miscarriage, a correction of the malposition may be expected to cure the sterility with a reasonable amount of certainty if all other causes can be excluded.

*Hypoplastic Malpositions.*—Operative treatment for hypoplastic malpositions is successful in only a limited number of cases. We have pointed out that in these cases there may be numerous possible factors causing the sterility, of which the misplacement is only one. Inasmuch as the malposition of the uterus is the only tangible element in the condition which we can materially correct, operative treatment is usually indicated, for success follows sufficiently often to make surgical interference justifiable, though with our present knowledge it must be admitted that it is always to a certain extent experimental.

Surgical treatment is in most cases directed to a correction of the anteflexion and stenosis of the cervix, and ranges from simple dilatation to elaborate abdominal or vaginal operations. Simple dilatation without other surgical measures is successful in a small number of cases. It happens sufficiently often, however, to make it advisable in any hypoplastic case, either as an operation itself or in connection with some other more elaborate procedure. Dilatation, however, has no permanent effect on the position of the womb, and the flexion practically always reasserts itself almost immediately. The use of a uterine stem-pessary after dilatation according to the method recommended by Davenport many years ago is not infrequently successful according to those who employ the method. It should be remembered, however, that the placing of a stem-pessary in the uterus is unsurgical in principle and is sometimes followed by infection of the tubes.

Operations for sterility in hypoplastic conditions of the uterus are identical with those for dysmenorrhea (see page 554).

After all has been said of operations for sterility in hypoplastic cases, it must be admitted that only a comparatively small percentage result in success. It is a question, therefore, if such haphazard operating is justifiable. It may be answered that in the majority of these cases the sterility is associated with severe dysmenorrhea, and that, in general, the same operation is indicated for both conditions and, therefore, justifiable for the relief of pain. None of the operations are dangerous, and do not, therefore, entail an unjustifiable risk, even in the absence of dysmenorrhea.

*Salpingitis.*—Although gonorrheal salpingitis is one of the most common causes of sterility, all women who have had salpingitis are not necessarily doomed to sterility. We have a sufficient number of cases in our series to show conclusively that in some instances gonorrhea of the tubes heals spontaneously, the final proof of which is a later normal pregnancy. A case of salpingitis which is afterward complicated by a tubal pregnancy cannot be said to be cured, as the permanent results of the pathologic processes in the mucous membrane are enough to interfere with the complete passage of the ovum. If, however, a

normal pregnancy takes place, we may regard the tube as having been restored to its normal functionating condition.

It is this possibility of restoring a woman to fertility that forms the most important foundation stone of conservative surgery in cases of gonorrheal salpingitis, and is more to be considered than the matter of retaining functionating organs, because, as we constantly see, the general results as to future general health are apt to be better after hysterectomy than after partial conservation.

The cases in which an attempt should be made to secure fertility are young unmarried women, or married women who are particularly anxious to have children. The subject should always be considered before operating on such cases, and should be discussed with the patient beforehand. The possibility of leaving the tubes in a condition where impregnation may later take place cannot always be foretold, as it is not uncommon to find them much more diseased than was supposed, so that the patient must be made thoroughly acquainted with the chances in order to avoid later disappointment. On the other hand, many patients are overanxious to have all their pelvic organs removed after the discomforts and suffering of pelvic inflammatory disease, and it is sometimes necessary for the surgeon to urge such patients to take the chances of a conservative operation in order to provide against possible later domestic unhappiness.

The various operations for securing or preserving fertility in women suffering from chronic pelvic inflammation are described in Part III. It not infrequently happens that although one tube is obliterated, adherent, and seriously damaged, the opposite tube remains patent and with few adhesions. In such a case the diseased tube should be completely exsected from the cornu of the uterus. The removal or conservation of the ovary depends on the amount of destruction which it has suffered and also on the condition of the other ovary. In some cases we have flushed out the remaining tube with 70 per cent. alcohol and sterile water. Whether this maneuver is of any value is doubtful.

In another class of cases both tubes are sealed at the fimbriated end, yet have escaped serious injury otherwise. In such a case it may be possible to preserve a portion of both tubes by resecting the outer third, or it may be necessary to extirpate one and preserve a part of the other. Resection of a portion of a tube should never be employed except as a means to preserve the patient's fertility, for there is always the possibility of a later acute infection of the proximal stump. If the tube is resected for the purpose of fertility it is left as long as possible, and a plastic operation is performed on the distal end of the tube in order to preserve an open ostium. The usual method of performing a so-called stomatoplastic operation on the stump of the tube is simply to approximate the tubal mucous membrane to the peritoneal covering of the tube by means of fine interrupted catgut sutures. A more effective method is to slit the tube longitudinally for $\frac{1}{2}$ to $\frac{3}{4}$ inch and to apply only enough sutures to control the bleeding, as it is thought that the sutures favor an adhesive closure

of the lumen. Still another method is to engage the end of the tubal stump in a slit in the ovary.

A third class of cases, where fertility is desired, comprises those conditions where both tubes are beyond repair, but where one or both ovaries are in fairly good condition. The only possibility in these cases is, after extirpating the tubes, to implant a piece of ovary in each cornu of the uterus. The chances of success in this operation are, of course, extremely small. Successful results by this method have been secured in animals, and a few cases of impregnation have been reported in human beings. (See below.)

In cases where pregnancy has ensued after leaving an entire tube it may be asked if the operation has been instrumental in securing this result. We are inclined to think that it is, though indirectly. The removal of the more actively diseased tube by a careful technical operation, and the usual suspension of the uterus by some appropriate method, leave the organs in a position much more favorable for impregnation, and in many cases prevent the further formation of immobilizing and obstructive adhesions. The general health of the patient is usually greatly improved, while the sexual functions, which are sometimes disturbed by the chronic pelvic disease, may be restored to the normal condition.

In order to determine the percentage of possible impregnation after chronic pelvic inflammation we wrote letters to many patients who had had conservative operations for this disease, and have a series of 90 cases of whom we have exact data. All of these 90 cases were in the child-bearing period. All had pelvic inflammatory disease, a very high percentage of which was doubtless of gonorrheal origin. Microscopic examination of the portions of the tubes or ovaries confirmed in every case the diagnosis of salpingitis. In all of the cases operations were done which would conceivably leave the patient fertile, and comprised such procedures as exsection of one tube, resection of both tubes, exsection of one tube and resection of the other, resection of the tube and insertion of the ostium of the tubal stump in the ovary, etc. In some cases both tubes were exsected and ovarian tissue implanted in the uterine cornua. No case was included where both tubes were exsected without implantation.

Of the 90 cases, 16, or 17.7 per cent., conceived at varying times after the operation. Of these 16 conceptions, 11 were normal pregnancies, while 5 ended in abortion.

In 55 cases an entire tube was left in, and of these, 10 conceived, or 18 per cent. In 35 cases both tubes were operated on, one or both of them being resected, and having a stomatoplastic done on the ostium of the stump of at least one. In other words, these cases had only a part of one tube or parts of both tubes left. One was a case of implantation of ovaries in the uterine cornua. Of the 35 cases, 6 conceived, or 16.8 per cent.

In the 90 cases no calculation was made of the absence of exposure to conception from nonmarriage, divorce, widowhood, continence, use of preventives, etc., which if such data were included would reduce the total number somewhat and increase the percentage of fertility.

The high percentage of abortions is noticeable, and is not easily explained except on the theory that some chronic change has occurred in the endometrium which has left it unsuitable soil for the nourishment of the fetus. The condition commonly found in the endometrium is a chronic interstitial endometritis.

*Appendicitis and Perisalpingitis.*—Many cases of sterility are due to early appendicitis, as a result of an organizing plastic exudate which settles by gravity into the true pelvis. This exudate, at first serous, implicates the adnexa in adhesions during its drying stage. As a rule the adhesive process is mild, though occasionally it may succeed in burying the entire genitalia in an inextricable

mass of adhesions, simulating those of tuberculosis. In the average case the fimbriæ of the tubes become inverted and closed by a fine membranous adhesion; or they may be partially or completely adherent to the surface of the ovary. The ovary is rather lightly adherent to the posterior leaf of the broad ligament and is apt to have spread over it a thin velamentous membrane of adhesions. Cases of this kind are especially favorable for the restoration of fertility—by a conservative operation. The operation consists first of freeing the fimbriæ. This can be done by delicate dissection of the obstructing membrane. A few minute clips with the scissors allow the fimbriæ to effloresce in a remarkable way. Care should be taken to cause as little injury and bleeding as possible. The velamentous membrane covering the ovaries is then stripped off. In some of these cases, where pregnancy has occurred after operation, the tubes have not been *completely* closed. Gas inflation would have evoked the diagnosis of "patent tubes" and the patient would not have been operated upon. It is for this reason that we do not have as great a reliance on this means of diagnosis as do some.

Perisalpingitis may also be the result of puerperal infections, the effect being somewhat like that from appendicitis, though usually more severe. Conservative operations for pelvic inflammation following appendicitis and puerperal infections are much more favorable from the standpoint of curing sterility than are those performed for gonorrheal salpingitis.

(For a discussion of the relationship of appendicitis to sterility see Graves, Annals of Surgery, 1920.)

*Diagnosis of Closure of the Tubes.*—In a case of sterility where closure of the tubes from pelvic inflammation is considered it is often difficult to make an accurate diagnosis, for the adhesive process may not be detected by digital examination. If there has been a history of gonorrhea, "inflammation of the bowels," abortion, or early appendicitis the diagnosis may be shrewdly guessed at. A recent means of detecting the patency or non-patency of the tubes is that of Rubin, who has popularized the so-called gas inflation method. Rubin has perfected an apparatus by which carbon-dioxid gas is forced into the abdominal cavity through a cannula passed into the uterine cavity. The pressure of the gas is recorded by a column of mercury, from which it can be determined whether or not the gas is flowing freely into the abdominal cavity or whether it is obstructed by non-patent tubes. This procedure which would at first appear to be unsurgical in principle has, however, the approbation of such operators as Peterson, Ward, Rongy, Richardson, and many others, who maintain that it is without danger if not used in cases of acute or subacute inflammation. There is no doubt that in certain cases gas inflation may be a valuable means of diagnosis, but we cannot believe that it should be used as a routine measure as some are now employing it. It is entirely apparent that the same dangers must exist in this treatment, in the presence of chronic pelvic inflammation, as exists with any intra-uterine instrumentation, such as curettage, uterine radiation, and artificial insemination.

A simple but not entirely accurate method of testing the patency of the tubes is to blow air into the uterine canal by means of a rubber insufflator such as is used by otologists. The rubber bulb is fitted with a cannula which is inserted into the uterus. If the tubes are patent the air when forced in can be heard whistling through the tubal isthmus. By placing a stethoscope on the abdominal wall it can be determined whether one or both tubes are open.

*Endocervicitis.*—Some of the most brilliant results in the treatment of sterility are those gained when the condition is due to endocervicitis. As we have seen, conception may be prevented in these cases by the mucous secretion, which either blocks the passage of the spermatozoön mechanically or, by becoming acid, destroys its vitality. Success in these cases depends, of course, on the integrity of the other pelvic organs.

In mild cases of endocervicitis a simple cureting and thorough removal of the plug of mucus is often followed by early conception. If it is suspected that the endocervicitis is due to gonorrhea, great care should be exercised in cureting the cervix, for it is not difficult to extend the disease to the tubes. The operation should, therefore, be kept below the level of the internal os.

When endocervicitis resists all ordinary treatment it is necessary to resort to surgical measures, the best operations being those of Schröder or Sturmdorf, by which the most of the mucous membrane of the cervix is exsected. We have performed this operation several times for sterility, but, though it has been successful in removing the discharge, conception has not taken place in any of the cases. This may be due to undetected adnexal disease. It is possible, too, that the removal of the cervical mucus is a factor in the continued sterility, for it is thought that this mucus is of great importance to the spermatozoön. On the other hand, we have observed several cases of impregnation after high amputation of the cervix.

*Mild Disturbance of Endocervix.*—The physician is frequently called upon to treat cases of sterility in which no definite anatomic or constitutional cause for the condition either in husband or wife can be discovered. It is probable that in a certain number of these cases there is some disturbance in the chemical reaction of the cervical or vaginal secretions. The alkalinity of the cervical secretion is absolutely essential for the passage of the spermatozoön into the uterine cavity, and it is likely that mild catarrhal conditions of the endocervix may modify the secretion so that it becomes hostile to the life of the germ-cell. It is possible, too, that mild catarrhal or other disturbances of the endocervix may interfere with the proper functioning of the cervical glands during cohabitation. It has been shown that normally these glands secrete and press out during sexual excitement fine mucous threads from their ducts. These threads (so-called "Kristeller") are alkaline in reaction, and are the paths by which the spermatozoa mount into the cervical canal. There is no doubt that mild inflammatory processes or the retention of inspissated mucus in the cervix may interfere with this important function.

*Ovarian Implantation and Transplantation.*—When one considers the extraordinary success that has been attained in modern times by the transplantation of various organs of the body, one cannot help feeling that this field of surgery may in time become of value in the treatment and cure of certain forms of sterility. Investigators are working continually in this line, and a certain amount of success has been attained, especially in animals. It is evident that transplanted ovarian tissue is enabled, for a while at least, to retain its function, though eventual atrophy usually takes place in a comparatively short period of time. We are here chiefly interested in those experiments which have resulted in impregnation. Numerous instances have been reported in animals where successful pregnancy has resulted both from auto- and heterotransplantation. Among those who first reported successful results were Krauer, Ribbert, Herlitzka, Grigorieff, and Rubinstein. In one case a rabbit became pregnant one and one-half years after the operation. Grigorieff saw 4 out of 12 rabbits become pregnant after transplantation. In more recent times interesting experiments have been carried on to test the influence of heredity in cases of heterotransplantation, by which it is found that the heritable qualities of the original germ-cells are not changed by the new host.

A few cases of impregnation following transplantation in human beings have been reported. The most famous one is that of Morris. Morris' case was one of pelvic peritonitis in which both adnexa were removed and a piece of ovary implanted in the end of one tube. This patient aborted four months after the operation and then menstruated for four years.

Frank in 1898 reported 3 cases of autotransplantation of the ovary, in one of which pregnancy going to full term took place. In another, probable abortion occurred, and in a third there was a suspected extra-uterine pregnancy. In 1905 Halliday-Crom reported the following case: A patient had amenorrhea following a miscarriage, with symptoms of change of life. An operation was performed and the ovaries, which showed small cystic degeneration, were removed and an ovary from another woman was implanted. Menstruation appeared four months later, and four years after conception took place, with normal birth.

We have had one case similar to that reported by Morris in which abortion probably took place several months after operation. The case was reported as one of abortion by her family physician, but as the products of conception were not seen it cannot be regarded as absolutely proved. Franklin H. Martin and Malcolm Storer have reported similar cases.

The lack of success that most ovarian transplantations meet with is undoubtedly due to our lack of knowledge of a proper technic, and the more or less accidental successes which occasionally take place convince one that sooner or later, as the science of surgery advances, a means will be found of transplanting the ovary so as to maintain its functions with constant result. If such a result can be attained, many cases of sterility due to gonorrheal or tubercular disease or to ovarian deficiency will be curable. In the case of transplantation from another woman the question of who is the mother would become an important one. According to law, the woman who bears the child would be regarded as the mother, but from a biologic standpoint the woman who originally produced

the germ-cells of the ovary should be considered the true mother, for from her the child would derive its heritable characteristics.

*Organotherapy.*—For a full discussion of this subject, see page 67. It may be said here that the administration of ovarian extracts has had very little effect in the treatment of sterility.

*Artificial Impregnation.*—At the present day very little is heard of artificial impregnation in the human race, the practice having fallen into a certain amount of disrepute as a result of religious, social, and even legal objections. There is no doubt, however, that the great success that has been attained in recent years in the artificial impregnation of domestic animals will lead eventually to a more extended trial of its possibilities in the treatment of sterility in woman. Artificial fertilization of fishes was done successfully as early as the year 1700, and has been developed scientifically since the middle of the last century, so that at present it is an extremely important factor in the industry of pisciculture. In the year 1780 Spallanzani succeeded in artificially fertilizing a bitch, and was the first to impregnate thus an animal of the mammalian type. This experiment of Spallanzani attracted much attention at the time, but very little was done in animal fertilization for more than a century. In recent times the procedure has again been taken up, and has been put to very practical use in the breeding of domestic animals. Everest Millais reported 15 successful results out of 19 trials in fertilizing bitches, and showed that these results equaled those of natural methods. Elias Iwanoff, a Russian, worked on the artificial breeding of horses, and in 1907 reported that results were even more successful than by natural breeding. He succeeded in fertilizing mares that had previously been sterile. His experiments with cattle, sheep, and other domestic animals produced a like result. Since then the process has been widely adopted by breeders of animals.

To Marion Sims belongs the credit of being the first to fertilize a woman artificially, which he did in 1866. The operation, however, has been little practised, and only a comparatively few cases have been reported. Rohleder, in his monograph, collects all the cases from the literature, including his own, and, making allowances for several doubtful instances, reports 65 cases with 21 successful results. Döderlein has reported another case. The subject has been exhaustively treated by Rohleder in an appendix to his book entitled "Die Zeugung beim Menschen," to which the reader is referred for a detailed description of the operation. The technic is extremely simple, and by the method suggested by Rohleder there seems little danger of sepsis if proper precautions are taken.[1] By this method the semen is injected into the cervical canal after a slight dilatation.

[1] Since writing the above statement in the first edition of this book the author has encountered a case of pelvic peritonitis induced by an operation for artificial insemination. The patient when seen had all the symptoms of a general peritonitis, the onset of which had occurred about thirty-six hours after an injection of semen into the uterine cavity. Under treatment the symptoms became localized in the pelvis. The pelvis itself became hard and boardlike, in the manner of an old-fashioned cellulitis. The patient ultimately recovered after weeks of invalidism.

By the technic used by Sims the few drops necessary for injection were collected from the posterior vault of the vagina post coitum. Rohleder criticizes this method, because the spermatozoa are deposited and left for a time in the acid secretion of the vagina, which is inimical to their life. He, therefore, takes the semen from a condom and injects it immediately into the cervix. The operation is done during the first few days after menstruation and immediately post coitum. This last he considers important, as at that time the alkaline secretion of the cervix is more profuse, and hence more favorable to the life of the spermatozoön. It is of very great importance to exclude the possibility of a gonococcus infection by a careful examination of the genitalia of both husband and wife. More than one operation has resulted in gonorrhea.

It is evident that artificial impregnation is only indicated when the genitalia of the woman are practically normal except for slight deviations, such as anteflexion of the cervix.

## General Symptomatology in Gynecology

In treating gynecologic patients it is of extreme importance to learn the essential symptom for which the patient seeks relief. The essential symptoms in pelvic disease are quite definite, easily classified, and are comparatively reliable guides to a correct diagnosis. In taking the clinical history of a gynecologic case the chief complaint must first be sought, and this often requires tact and intelligence. Women with pelvic disease usually suffer from a multitude of troubles, each one of which they are likely to enumerate before mentioning the principal cause of their suffering. Many patients, from various motives, purposely conceal their real trouble in giving their clinical history, leaving it for the doctor to find it out for himself, while others, in the nervous excitement of a consultation, actually forget to mention the most important information.

Most of the essential symptoms of gynecologic disease can be divided into three main groups: (1) Those due to abnormal secretion; (2) those due to abnormalities of bleeding, including irregularities of menstruation; (3) those due to pain. It is the purpose of this section to interpret these symptoms in their relation to the various diseases which may cause them.

### SYMPTOMS DUE TO ABNORMAL SECRETIONS

Abnormal secretions from the genital tract not containing blood are generally spoken of as leukorrheal discharges. If a patient complains of leukorrhea it is necessary to know whether or not it is constant; if not, at what times it occurs, especially with reference to the menstrual period; if constant, how profuse it is; whether a napkin is necessary, etc. The patient must be further questioned as to the character of the discharge—is it thin and watery; is it white and milky; is it thick and creamy; is it brownish; is it greenish; does it have a foul odor; is it accompanied by pain; does it irritate the external genitals; is it affected by nervous excitement or exhaustion. It is important also to know the duration of the discharge—did it come on suddenly; was it associated at first with pelvic pain or burning micturition; did it first come on following childbearing; was it present before marriage, etc. The replies to these questions give a most valuable clue to the diagnosis.

The next step is to determine the seat of the abnormal secretion, and this is done by inspection of the external genitals, by digital examination per vaginam, and by inspection of the vagina and cervix through a speculum. Discharges from the genital system above the cervix must be diagnosed by inference and

by exclusion of the parts available for direct examination. There is, of course, some physiologic secretion from every part of the genital tract, from the end of the tubes to the vulva, but it is not noticeable to the patient under normal conditions. Abnormal secretion of the tube downward is extremely rare on account of the valve-like action of the tubal isthmus which prevents fluids passing in the direction of the uterus. Under rare conditions, however, a hydrosalpinx or a pyosalpinx may force open the valve and discharge its contents through the uterus and vagina. The first is technically called "hydrops tubæ profluens," and the second "pyosalpinx profluens." There is a sudden unexpected flooding gush of water or pus, as the case may be, the amount of which is usually greatly exaggerated in the mind of the patient. In the case of a pyosalpinx profluens the discharge is usually followed by relief of pain.

Non-bacterial hypersecretion of the endometrial glands evidently takes place, but it is very difficult to identify. Undoubtedly, conditions like malpositions, adherent pelvic peritonitis, etc., which produce hyperemia of the uterus and thickening of the endometrium, intensify the natural secretion. The secretion under normal conditions is very slight, composed as it is of a serous, albuminous fluid material non-mucoid in character. Conditions of hyperemia stimulate also the more active mucous glands of the cervix, so that how much of the leukorrheal discharge is due to the endometrium cannot be determined. It is probable that the non-bacterial discharges from the endometrium are rarely of much clinical importance. The temporary mild leukorrhea that follows the catamenia represents a hypersecretion of the endometrial glands, but must be regarded as physiologic.

Bacterial or infectious discharges from the uterine mucosa are comparatively uncommon. The gonococcus does not have a predilection for the endometrium and does not often leave a permanent infection. Acute gonorrheal endometritis does, however, sometimes occur, and produces a characteristic purulent discharge, which is always associated with an infection of the endocervix. Puerperal sepsis may also cause an acute or subacute endometritis from which may issue a purulent or seropurulent discharge. From both gonorrhea and puerperal sepsis there may result a chronic interstitial endometritis (*q. v.*) which may produce a chronic leukorrhea.

Tuberculosis of the endometrium, a comparatively rare disease, also causes a chronic discharge.

Other causes for leukorrhea from the uterine canal are sloughing mucous or myomatous polyps, submucous myomas, and adenocarcinoma of the endometrium. The amount and character of the discharge depends on the amount of sloughing, and may be very abundant and exceedingly fetid, simulating that from cancer of the cervix.

Long-retained products of conception, besides producing menorrhagia and metrorrhagia, cause a uterine discharge which, if sepsis is present, is foul and profuse.

Partial gynatresia, especially that resulting from senile atrophy, results in retention of the uterine secretions, producing hydrometra or pyometra, which may more or less periodically discharge its contents.

Most leukorrhea comes from the endocervix. The glands of the endocervix secrete a clear mucus which normally is hardly appreciable. Under conditions of irritation or infection they become very active and pour forth large amounts of mucus, which after reaching the vagina becomes coagulated and opaque, so that on issuing from the vagina it has the characteristic white appearance from which the term "leukorrhea" is taken.

Non-bacterial hypersecretion of the endocervical glands may occur in virgins, and is sometimes difficult to account for. There often seems to be an associated nervous element, many of the patients being of neurotic or excitable temperament. Nervous excitement and fatigue seem to stimulate the discharge. This can only be accounted for on the theory of a local hyperemia of the genital organs. In many of the cases of leukorrhea in virgins, however, there can be found a true erosion of the cervix near the external os, the repair of which will cause the leukorrhea to cease. (The cause of this so-called erosio virginis has been a matter of doubt, but it may be observed that in most of the cases there is a malposition of the cervix resulting from a retroversion or anteflexion of the body, so that the cervix comes in contact with the anterior vaginal wall. The erosion may, therefore, be due to friction.)

Lacerations of the cervix with ectropion and eversion result in a chronic inflammation and irritation of the cervical mucosa, resulting in hypersecretion of the glands. There is usually an associated mixed infection of various organisms. Of the bacterial infections of the cervix, gonorrhea is the most common, affecting as it does the surface epithelium, and producing later mixed infection of the deep-lying glands. The chronic endocervicitis from chronic gonorrhea (*q. v.*) is most persistent and difficult to treat.

In cancer of the cervix, leukorrhea is the earliest symptom, and is of clinical importance on account of its peculiar character. The discharge is thin and watery as a result of the serous transudation from newly made capillaries of the growing tumor. Infection and sloughing of the cancerous mass imbues the discharge with a characteristic foul, almost intolerable odor.

A similar discharge may sometimes come from a sloughing myomatous polyp presenting at the cervix.

Secretion from the vagina is normally very slight, and the vagina of the adult is also comparatively resistant to infection. In childhood it is very susceptible to gonorrhea, and the discharge therefrom is exceedingly purulent, abundant, and persistent. Vaginal discharges in mature women result from saprophytic and fungus infections in the unclean, and from secondary infections from neglected gonorrhea.

Foul vaginal discharges result from long-contained foreign bodies. Of these, the worst offender is the vaginal pessary, especially those of the soft-rubber

variety. Tampons are frequently left in from the carelessness of the patient or her physician and result in a most offensive discharge.

A very important and too little recognized cause of vaginal leukorrhea is that which results from senile atrophy. The color of the discharge, usually very white, is due to its containing a great amount of desquamated vaginal epithelium. It may be tinged with blood.

Discharges from the external genitals are usually quite obvious in their origin. Chronic inflammation of Bartholin's glands, especially if an abscess has been lanced, often results in a discharging sinus, from which issues an irritating seropurulent discharge. Chronic inflammation of Skene's glands, with a mixed infection, produces a like result, as does also a chronic gonorrheal urethritis.

## ABNORMALITIES OF MENSTRUATION

Under menstrual disorders are included amenorrhea, menorrhagia and metrorrhagia, dysmenorrhea, and vicarious menstruation.

**Amenorrhea** is physiologic before puberty, during the months of pregnancy, and after the menopause. There is some debate as to whether the amenorrhea that accompanies the first months of lactation is physiologic or pathologic. Normal lactating women menstruate from six weeks to four months after labor. If the amenorrhea lasts longer than this it probably signifies a too great atrophy of the uterus. In women who nurse their children too long, or who have too frequently repeated labors, there is sometimes a long-continued or even permanent amenorrhea due to excessive genital atrophy. Lactating women during the amenorrheic period do not often conceive.

Amenorrhea may be the result of genital aplasia or marked hypoplasia. Imperfect development of the uterus and vagina may be associated with functionating ovaries with no appearance of blood, but with periodic monthly general symptoms of congestion, the so-called molimina of menstruation. Delayed puberty is often evidence of some degree of hypoplasia or infantilism, and if the defective development is marked, it may be followed by a premature climacteric.

The absence of blood that results from atresia of the vagina with fully developed uterus and ovaries is not a true amenorrhea, for here the uterus actually menstruates, the blood being dammed back in the vagina, uterus, and tubes (hematocolpos, hematometra, and hematosalpinx).

Castration produces amenorrhea. The reported instances of menstruation following castration are, many of them, the result of leaving in a small amount of ovarian tissue or the possible presence of an accessory ovary. Some of the cases of this kind are difficult to explain. Hysterectomy without the removal of the ovaries is followed by cessation of the menses, though sometimes the molimina of menstruation may persist.

For the maintenance of the menstrual function only a very small amount of ovarian tissue is requisite. This is observed in bilateral ovarian tumors even of enormous size, where, as a rule, there is no disturbance of the monthly

periods. It is stated (Zacharias) that even though the parenchyma of the ovary is destroyed, the hilus of the ovary is sufficient to preserve menstruation. On the other hand, when most of the ovarian tissue is destroyed by disease or removed by operation, the menopause is usually premature.

Amenorrhea may be caused by destruction of the uterine mucosa. Examples of this have been seen after a too vigorous curetment or cauterization, or chemical treatment of the endometrium.

There are certain general constitutional disturbances which may produce amenorrhea. Of these, one of the most important in the young is chlorosis, though it may also cause severe menorrhagia. The same is true of simple anemia. Why deficient blood suppresses menstruation in one and stimulates it in another is an unsolved problem.

Of very great importance is the amenorrhea which results from disturbances of the various glands of internal secretion, such, for example, as Basedow's disease, Addison's disease, myxedema, and the various diseases that result from disturbances of the pituitary body. In these conditions the amenorrhea is associated with an atrophy or defective development of the internal and external genitals.

Defective ovarian function, signified by scanty menstruation, delayed puberty, or permanent amenorrhea, often accompanies abnormal adiposity of youth (Fettkinder) or the sudden rapid accession of fat in the mature, in both of which cases there is usually some pathologic condition of one of the internal secretory organs.

The relationship of tuberculosis to amenorrhea is of very important clinical significance. All forms of tuberculosis may be associated with scanty or suppressed menses, more especially the genital and peritoneal, and less frequently the pulmonary types.

Certain chronic constitutional diseases are apt to be accompanied by amenorrhea. Among these, the most important are diabetes mellitus and insipidus, chronic nephritis, leukemia, syphilis, cancer cachexia, morphinism, and alcoholism.

Amenorrhea is also common in the various forms of functional and chronic psychoses, in epilepsy, and progressive paralysis.

Under the term "functional amenorrhea" are classed such cases of temporary cessation of the menses or delayed menarche as are not related to any definite pathologic condition. One of the commonest causes of functional amenorrhea is some sudden psychic emotion, especially that of fear or anger.

The menses are often suppressed in their course by chilling of the body from cold baths, exposure to the weather, wet feet, etc.

Anxiety from fear of pregnancy or from great desire to have children may delay the period for days or even months. In the latter case, motions of a child may be imagined and there may be apparent enlargement of the abdomen. These are the so-called "phantom pregnancies."

A common cause of functional amenorrhea is a change of climate or occupation, as seen commonly among domestics.

Vesicovaginal fistulas are not uncommonly associated with amenorrhea.

**Menorrhagia.**—By this term is meant excessive menstruation. This may consist of an increased amount of blood at the usual menstrual period, or a prolongation of the period, or a too frequent recurrence of the menses. It implies that during the interval between the periods there is no appearance of blood.

The word "menorrhagia" must, to a certain extent, be used relatively. The amount of blood lost at each menstrual period varies considerably in different individuals, as has been seen. What might be a normal flow for a robust, full-blooded matron might constitute a depleting hemorrhage for a delicate, poorly nourished unmarried woman. Some women have a physiologic interval of twenty-three days, but in a woman whose normal interval is twenty-eight days the early recurrence of the menses may be an indication of serious disease.

The coagulability of the menstrual blood is of importance, for clots signify some abnormality. If the clotting is considerable the case is usually to be regarded as one of menorrhagia.

It is not always easy to determine the existence or the extent of the menorrhagia, as one is obliged to rely chiefly on the patient's history. This includes the routine questions as to the time of puberty, length of each menstrual period, regularity and duration of the interval, amount of blood lost, presence or absence of pain, and the date of the last menstrual period. From these questions fairly accurate data are gained as to whether the patient's periods last over too many days or whether they are too frequent. The amount of blood lost is more difficult to ascertain unless the amount is so great as to cause flooding, hemorrhages, fainting spells, and obvious anemia. In the more moderate cases one must judge from inference, and this can best be done by inquiry as to the average number of napkins or pads used during the period. Patients differ in this respect according to their social station and personal cleanliness, but if the menstruation is sufficient to soak the pads a change is imperative, so that in important cases the error is not great. The average normal woman of cleanly habits uses three or four napkins a day, the total number for the period averaging twelve to sixteen. If more than this are used, menorrhagia is suspected, and if the number reaches eight to twelve a day the diagnosis is established.

If it appears evident from the patient's history that she is menstruating too much or too often, the duration of the condition must be determined. Has menstruation always been profuse since it began; was it increased by marriage or childbirth; does it date from a miscarriage; has there ever been an attack of "inflammation of the bowels" (pelvic inflammation); has the increase of flow been gradual or sudden; has there been enlargement of the abdomen or a lump to be felt in the abdomen, are questions the answers to which are important before making a physical examination.

*Causes of Menorrhagia.*—We have seen that a menstrual flow in the newborn is a physiologic result of the influence of the placental tissue on the genital organs, and that precocious menstruation is due to disturbances of the thymus and pineal glands.

Menorrhagia during the first decade following puberty is not uncommon and may be very severe and intractable. Some of these young patients are chlorotic and anemic. In others the cause of the bleeding is obscure. It may be, and doubtless often is, due to some disturbance in the internal secretion of the ovaries or of other internal secretory glands, or it may be the result of defective musculature of the uterus or anomalies of the circulatory apparatus. These are only theories, and have not yet been scientifically established. Undoubtedly, some cases of youthful menorrhagia are the result of masturbation.

Menorrhagia may be the result of passive congestion of the uterus, and is not infrequently seen with retroflexion and prolapse of the uterus. It is probably due to a congestion of the uterine musculature which diminishes its power of contraction. In cases of this kind there is usually an associated varicose condition of the veins contained in the broad ligaments.

Excessive or abnormal coitus is said to be a cause of menorrhagia. Acute infectious diseases, especially influenza, are an occasional cause.

Pelvic conditions which tend to abnormal fixation of the uterus, such as the adhesions of chronic pelvic inflammatory disease, conduce to menorrhagia. It is difficult to say whether this is due to an interference with the normal muscular contractions of the uterus, or whether it is the result of a chronic interstitial endometritis.

Menorrhagia and metrorrhagia are frequently met with in syphilitic women, and are often controlled by specific medication. According to Gellhorn the abnormal bleeding does not signify luetic lesions in the uterus or ovaries, for these organs seem to be more or less exempt from local syphilis. It is due either to constitutional impairment of health with endocrine disturbance, or to a complicating gonorrhea, or to the result of repeated abortions.

True chronic inflammation of the endometrium, we have seen, is not particularly common. When it does occur, it is usually the end-result of an acute gonorrhea or puerperal sepsis. Chronic endometritis (*q. v.*) is apt to cause menorrhagia. This is especially true after incomplete abortions, where small portions of fetal tissue or of blood-clots become semi-organized and attached to the uterine wall and serve as a continual source of irritation to the mucosa.

Hypertrophy and hyperplasia of the endometrium were formerly thought to be the chief primary cause of menorrhagia. Most of the familiar conditions associated with excessive menstruation, like pelvic inflammations, fibroids, malpositions, etc., were supposed to create in some way a thickening or inflammation of the endometrium with consequent bleeding. It is true that hypertrophied mucosa can usually be found in such conditions, but it is now known that in most cases the supposedly diseased endometrium is no more nor less than a phase of the physiologic monthly cycle of congestion.

Hypertrophy of the endometrium is not found to be a very common cause of menorrhagia, but occasionally the process passes beyond the physiologic limits and becomes permanent. The thickened endometrium is thrown up into irregular folds, which may be so pronounced as to assume a polypoid appearance. This condition, technically called "polypoid gland hypertrophy," may cause persistent and intractable menorrhagia. The etiology is obscure. An advanced form of this disease is the non-malignant adenoma of the uterus, which causes excessive flowing and is not curable by cureting. It lacks the microscopic appearance and clinical course of an adenocarcinoma.

Tumors of the ovaries and operations on the ovaries have some influence on menstruation. The non-malignant tumors, as a rule, affect menstruation very little, but if torsion takes place, menorrhagia is apt to follow. Malignant tumors of the ovaries are very frequently accompanied by increased menstrual bleeding. Operations on the ovaries, especially resections, are often followed by a premature or profuse menstrual period.

Menorrhagia in its most characteristic and constant form occurs in connection with uterine myomas. The most severe forms of menorrhagia result from submucous fibroids, but all myomas of whatever kind have a tendency to produce an increase of the menstrual flow. The excessive bleeding in the case of a submucous myoma does not come from the mucous membrane covering the myoma, but from the freer portions, and is always venous in character (Sampson).

Myomatous polyps often cause menstrual bleeding of extreme severity, as do mucous polyps of the cervix and endometrium.

Menorrhagia during the preclimacteric and climacteric periods is very common. This is frequently due to the presence of fibroids of the uterus, and occasionally the result of chronic hypertrophy of the endometrium, but in a great many instances no anatomic cause can be found. There is no doubt that a loss of tone in the musculature of the uterus, with consequent insufficiency of uterine contraction, plays an important rôle in these cases.

It is not at all unlikely that the menstrual disorders of the climacteric, as well as those of the menarche, are the result of irregularities in the hormones of the ovaries. It is thought by some that practically all menorrhagias are caused ultimately by a disturbance of the internal secretion of the ovaries, and there is much evidence that this is true.

**Metrorrhagia.**—Uterine bleeding that occurs independently of menstruation and ovulation is called metrorrhagia. All metrorrhagia is pathologic, and must always be regarded in a serious light. Uterine bleeding during pregnancy is included as a metrorrhagia, and usually signifies some disturbance of the placenta, though there are cases where it is evident that the bleeding comes only from the decidua. This may occur periodically at the usual time of the menstrual wave. It cannot be regarded as a true menstruation, as it is not accompanied by ovulation. The bleeding that results from separation of the placenta and abortion, from placenta prævia, and hydatidiform mole is metror-

rhagia, and is of serious import, as is also the continuous or interrupted post-partum bleeding resulting from retained products of conception, placental polyps, and attached organized blood-clots (sanguineous mole). Persistent bleeding after one or more curetments for retained products or hydatidiform mole may be indicative of chorio-epithelioma.

Bleeding from the decidua of extra-uterine pregnancy is also an important form of metrorrhagia. This may or may not be preceded by a period of amenorrhea, for a tubal abortion not infrequently occurs within the first month of pregnancy. The bleeding of the decidua may, therefore, occur at the time of or previous to the regular menstrual period. Abortion within the first month is rare in uterine pregnancy, but in tubal pregnancy it is said that it takes place in one-fourth of the cases (Baisch).

Outside of the various conditions referable to pregnancy, metrorrhagia is usually due to malignant tumors or necrotic polyps. In these cases the bleeding is the result of the breaking off of bits of tissue from the growth or from the erosion of blood-vessels. The bleeding may be constant, or it may result from energetic movements of the patient, from coitus, or from digital examinations.

Of this class of cases the most common and most important are those of cancer of the cervix. The bleeding may be very profuse, but is always venous in character and is rarely fatal. Bleeding from cancer of the body is similar to that from cervical cancer, but, as a rule, is less severe. Bleeding from necrotic polyps varies from a slight tinge of blood to very serious hemorrhages.

After the menopause all bleeding is "metrorrhagic" and should cause grave concern, with immediate and thorough investigation. Besides cancer of the cervix and body and necrotic polyps, hemorrhages at this period often indicate the degeneration of uterine fibroids. It should be borne in mind, however, that mild bleeding after the menopause is very frequently due to senile atrophy and vaginitis, which, together with the leukorrheal discharge that is usually present, may closely simulate the hemorrhage of cancer.

Various ulcerations of the vagina and cervix, such as result from foreign bodies like ill-fitting pessaries, may cause metrorrhagia.

Severe lacerations of the cervix, with ectropion and erosion, sometimes cause bleeding, especially after coitus. In cases of this kind a specimen should always be removed and examined microscopically.

## PAIN

Pain plays a somewhat illusory part in pelvic symptomatology, for many of the most serious conditions often exist without giving the patient discomfort. This is due to the fact that the pelvic organs, though well supplied with nerves from the sympathetic system, are rather scantily endowed with sensory fibers. Thus, the cervix uteri is surprisingly anesthetic as far as the internal os, where, however, an extremely sensitive area is encountered. The uterus and ovaries,

too, are quite insensitive to pain, popular belief to the contrary. The pelvic peritoneum, on the other hand, is very sensitive and is an important factor in the symptomatology.

Although the relationship of pain to pelvic disease is, in a certain sense, secondary to the objective symptoms of abnormal secretion and menstruation, nevertheless a proper interpretation of it is very necessary. It has been a general belief that many of the pelvic pains of which women complain are from a neurotic or hysteric source. This idea has been greatly exaggerated and has led to much improper treatment, and it is the purpose of the writer to attempt to show, both in this section and in that on Nervous Diseases, that practically all pelvic pain has a definite anatomic and pathologic basis.

Affections of the cervix, on account of its insensibility, cause no local pain. Even the most extensive cancer causes no sensation in the cervix itself, pain in this disease not appearing until there has been extension into the parametrium or metastasis into the regional lymph-glands. Lacerations, erosions, and ulcerations of the cervix cause no direct subjective symptoms, nor does acute infection such as results from gonorrhea. The region of the internal os is extremely sensitive, as is readily observed in passing a sound into the uterine canal. This sensitiveness is apparent in the pains of essential dysmenorrhea, in the agonies of childbirth, and in the painful expulsion of clots in menorrhagia. It is quite possible that the backache of retroflexion is a referred pain, actually localized at the junction of the body and neck of the uterus.

The canal of the uterine body is, to a certain degree, sensitive. This is shown by pain and tenderness of the uterus in acute infections of the endometrium and occasionally in permanent gland hypertrophy. The pain of so-called uterine colic, such as results from contractions of the uterus on a gauze packing, is probably referable to the region of the internal os.

Much of the pain from infections of the pelvis has its seat in the peritoneum. Acute salpingitis is extremely painful, but this is due chiefly to peritonitis. Distention of the tube seems to cause little discomfort, for non-adherent hydrosalpinx is insensitive, while the distention of the tube by ectopic pregnancy usually gives no pain before rupture.

The rupture of a tubal pregnancy produces the most severe lancinating pain, which is probably the result of the sudden gush of blood into the peritoneal cavity (Baisch). Subsequent gushes of blood over the peritoneal surface are accompanied by lancinating pains.

The subject of **ovarian pain** is one about which there is much misapprehension. All pains in the sides of the pelvis are commonly referred to, both by patients and their physicians, as pains in the ovaries, whereas, as a matter of fact, the ovaries are comparatively insensitive organs. It is well known that even the largest ovarian tumors are painless so far as the ovarian tissue is concerned. If, however, torsion occurs there is intense pain, due to peritonitic irritation (Baisch). It is a mistake to suppose that small cystic degeneration

of the ovaries causes pain. This process has been shown to be physiologic up to a certain extent, but even if it becomes pathologic and reaches the stage of retention cysts, there is no pain unless the cyst becomes twisted or involved in peritoneal adhesions.

Chronic oöphoritis resulting from a true inflammation and infiltration of the ovarian stroma doubtless causes pain, but it is difficult to differentiate the pain that comes from the ovaries and that which is produced by the surrounding peritonitic inflammation which usually accompanies the oöphoritis.

Ovarian neuralgia is a term often applied to severe pains felt in the pelvis, especially by neurotic patients in whom no definite anatomic abnormality can be made out by digital examination. It is very doubtful if there is a true ovarian neuralgia, and it is probable that cases of this kind are imperfectly diagnosed as to their pelvic condition.

Another source of pain frequently ascribed to the ovaries is the so-called Hunner stricture of the ureter (*q. v.*).

The most common source of pelvic pain is that which comes from **inflammation** or **irritation of the peritoneum.** In the acute infections this is entirely obvious. When pelvic tumors like uterine fibroids and ovarian cysts become painful and tender it is almost certain that they have become complicated by adhesive peritoneal irritation or inflammation. Chronic adhesive peritonitis of the pelvis is far more common than is ordinarily realized, and even a mild grade, with few adhesions of the adnexa, may cause very discomforting pain. It is possible that pelvic adhesions may exist to a very considerable extent and yet remain undetected by the most expert examination. It is easy to see how such a condition might be regarded as an example of "ovarian neuralgia."

When the pelvic adhesions involve the neighboring organs the pain may be referred to these organs, namely, the bladder, the rectum, the appendix, and the colon. The source of the pain is, however, peritoneal in each case.

An extremely important type of pelvic pain is that which is represented by **pelvic pressure.** This may be exerted in three ways: (1) By the direct pressure force of a growing incarcerated tumor; (2) by the force of gravity resulting from abnormally heavy organs, and (3) by a loss of integrity of the supporting structures, so that the pelvic diaphragm no longer properly counteracts the normal abdominal pressure.

Examples of tumors that may become incarcerated are the retroflexed pregnant uterus, large myomata growing from the posterior wall of the uterus, usually pedunculated, ovarian cysts, especially those that are adherent or growing between the leaves of the broad ligament, and the large, rapidly growing postperitoneal tumors. The pressure pain in these cases is general and becomes more severe as the tumor increases. Pressure on the ischiadic nerves causes pain radiating into the legs. In advanced cases symptoms from obstruction of the rectum and bladder ensue.

Downward pressure from gravity is most often caused by uterine myomas,

when the tumors grow in such a way as to push the uterus downward in the direction which it takes in prolapse. Most fibroids of any significant size and weight cause pressure symptoms, but some do not, and others grow in such a way as actually to lift the uterus into a higher plane in the pelvis. For this reason myomatous tumors sometimes grow to a large size without giving the patient any discomfort. Gravity pressure also results from large congested, heavy uteri, even if not retroverted or prolapsed. This is not infrequently seen after repair of pelvic relaxation and suspension of the uterus, especially if it be attached to a deficient abdominal wall.

Downward pressure of the pelvic organs with symptoms is sometimes caused by ascites and by overlying ovarian tumors. The latter, however, unless adherent or incarcerated, usually ride high in the abdomen and give little pain.

The symptoms arising from relaxed supports, with resultant misplacement and descent of the organs, are not always those of actual pain, but rather of discomfort. The sensation is usually described as "bearing-down feelings," and is invariably associated with fatigue. A large percentage of the cases, but not all, have sacral backache. These symptoms are present in an exaggerated degree in cases of prolapse following hysterectomy, where, in finishing the operation, the surgeon has not properly suspended the vagina.

As is frequently emphasized in this book, pelvic pressure symptoms are of the utmost importance in their relation to the general organism of the patient and especially to the nervous system.

Pain in the side is a not infrequent accompaniment of prolapse, and is usually referred to the ovaries. In the absence of adhesions or disease of the tubes, these so-called ovarian pains, as a rule, actually arise from a congested varicose condition of the veins of the broad ligaments. This congestion produces a dull, constant ache similar to that experienced by men who suffer from varicocele.

Backache as a symptom of backward displacement of the uterus has been a subject of much debate. On account of the fact that many serious affections of the pelvis, including extreme retroflexion and procidentia, are without backache, it is believed by some that it is not a symptom of retroversion. Those who take this view also point to the fact that no satisfactory explanation has yet been given as to the exact cause of the backache. There is, however, indisputable evidence that in a large percentage of cases retroposition of the uterus is definitely associated with backache and that the retroposition in some way *causes* the backache.

It is very important to note that the **backache** caused by malposition of the uterus is always sacral or very low lumbar, and is always central. Backaches above this region have no relation to pelvic disease except so far as they may be the result of a general bodily weakness that has its origin in some pelvic affection. In the same way, pain between the shoulder-blades, pains in the trapezius muscles, or in the back of the neck and headaches bear only a

secondary relationship to pelvic disease. The sacral backache from retroversion does not differ greatly in character from several orthopedic conditions of this region, and from these it must always be carefully distinguished. Sacral backache may also be the result of pelvic inflammatory disease with peritoneal adhesions of the posterior pelvic wall.

Cancer of the cervix in its later stages causes an excruciating backache, but it is usually one sided and extends down into the gluteal and sciatic region. This pain comes only after extension of the disease into the parametrium and regional lymph-glands, and is always an indication of an advanced stage of the disease.

It has been said that **fibroids** are not inherently painful unless inflamed, adherent, or incarcerated. An exception to this is the occasional occurrence of pain from interstitial fibroids. This pain is characterized by a monthly periodicity, having usually a definite relationship to the menstrual periods. It is intermenstrual in its occurrence, and usually appears from a week to ten days before catamenia (so-called Mittelschmerz). The pain is referred rather definitely to the uterine region and resembles in character that of dysmenorrhea. Fibroids that produce this phenomenon are usually of small or moderate size and intramural in position. Sometimes the pain from these tumors is sporadic, coming on without warning, lasting several hours, and then disappearing for an indefinite period.

A special type of pain frequently seen in gynecologic patients is one that begins in the loins, extending backward into the lumbar region and forward into the lower abdomen. It is associated with general fatigue. Many of these patients are individuals of deficient muscular power who have gained weight rapidly. The pain is due to the dragging weight of a heavy abdominal wall on the muscles of the lateral abdomen and back, and can often be relieved completely by a properly fitting corset or abdominal support. If, in addition to the accumulation of fat, there also exists a diastasis of the abdominal recti muscles, the symptoms are much more marked and may necessitate an operation.

Another form of pain observed very frequently in women is that referred to the coccyx and termed **coccygodynia.** This pain is often severe and may be disabling. The causes of coccygodynia are usually referable to some trauma of the coccyx, of which the most common are fractures or dislocations from falls or from unskilful instrumentation at childbirth. The tip of the coccyx may by such injuries be displaced into such a position that it is continually exposed to slight traumatism, especially when the patient is sitting. The condition if severe may require surgical removal of the coccyx.

In many instances the pain is the result not of a serious injury to the coccyx, but to its anatomic structure, by which the tip is exposed to constant traumatism while the patient is in the sitting posture. Faulty positions in sitting may bring about a like result even when the anatomy of the coccyx is entirely normal.

Sometimes coccygodynia is regarded as a purely nervous manifestation.

It is probable that in most cases the pain is actual, though it may be overvalued in the patient's mind.

The **pains of menstruation** are dwelt on at length in the section on Dysmenorrhea, to which the reader is referred. It should, however, be emphasized here that in general the pains of pelvic disease, from whatever source, are usually aggravated during the period of menstrual congestion. This is notably true of pains resulting from immobilized organs like adherent adnexa, incarcerated tumors, etc., or from mild inflammatory processes like chronic appendicitis or catarrhal salpingitis.

The cramp-like pains of essential dysmenorrhea are to be regarded as representing the symptoms of a special disease.

**Painful micturition** is an important symptom in the treatment of gynecologic diseases. A sudden onset of painful burning urination is characteristic of acute gonorrheal urethritis, though by no means a constant symptom of the disease. Pain on micturition following pelvic operations usually indicates an inflammation of the bladder as the result of catheterization or traumatism to the bladder, or incidental infection. Later in the course of a convalescence from surgical operation it may indicate the presence of a pyelitis. Urinary discomfort, especially in elderly patients, often signifies a urethral caruncle, or prolapse of the urethral mucous membrane, or the irritation due to senile changes in the lining of the bladder and urethra. Long-continued urinary irritability is indicative of the various chronic inflammations of the urinary tract.

**Pain on defecation** suggests hemorrhoids, anal fissure, or anal fistula, and sometimes the involvement of the rectum by pelvic growths.

**Pain in the legs** is a common and often baffling symptom in gynecologic patients. In the case of extensive malignant disease of the pelvis or of large incarcerated tumors the pain is sufficiently well accounted for by pressure on the great nerve-trunks. In minor gynecologic affections, however, such as displacements, small tumors, etc., the relationship between the disease and the pain in the legs is less obvious. Often it may be traced to some orthopedic condition of muscle strain in which the pelvic trouble plays only a contributory part in lessening the general tonal resistance of the patient. During the convalescence from gynecologic operations pain in the calf of the leg or along the inner side of the thigh or in the groin should give warning at once of the possible presence of phlebitis, one of the most troublesome of surgical complications.

The subject of pain in its relation to gynecology is almost limitless, and the examples here given must be considered not as having exhausted the theme, but as being those of chief clinical importance.

PART III

# OPERATIVE GYNECOLOGY

## OPERATIONS ON THE VULVA

### VULVECTOMY

The indications for removal of the vulva are most commonly cancer, kraurosis, tuberculosis, elephantiasis, and esthiomene.

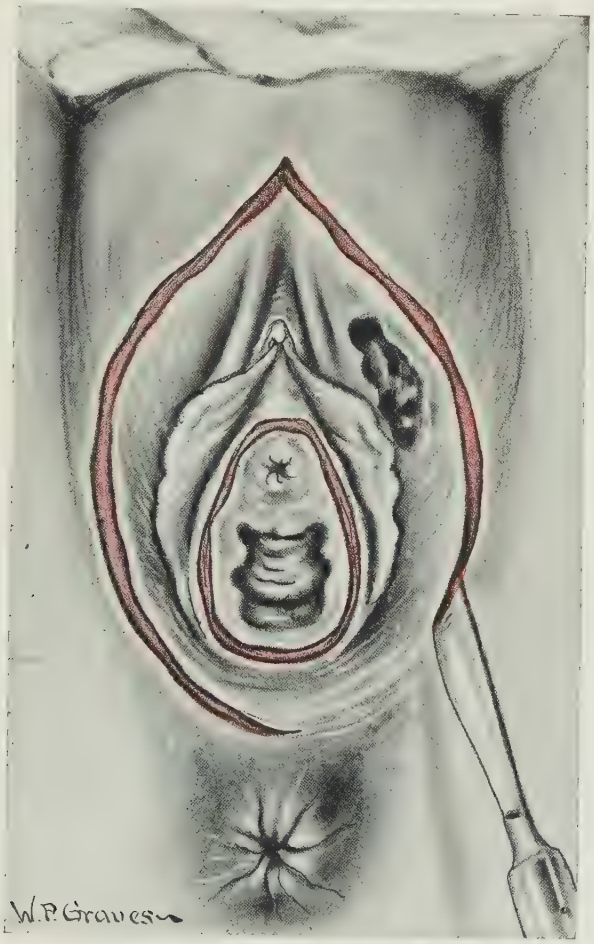


Fig. 234.—Vulvectomy.
The double lines show the position of the initial incisions. The area included between these lines is to be completely dissected away.

The operation is not a difficult one, but requires special attention to coaptation of the wound edges in order to safeguard against the predisposition which large wounds of the vulva have to sepsis.

An oval incision is made about the entire vulva external to the diseased tissue, extending from above the clitoris to a point between the fourchette and the anus.

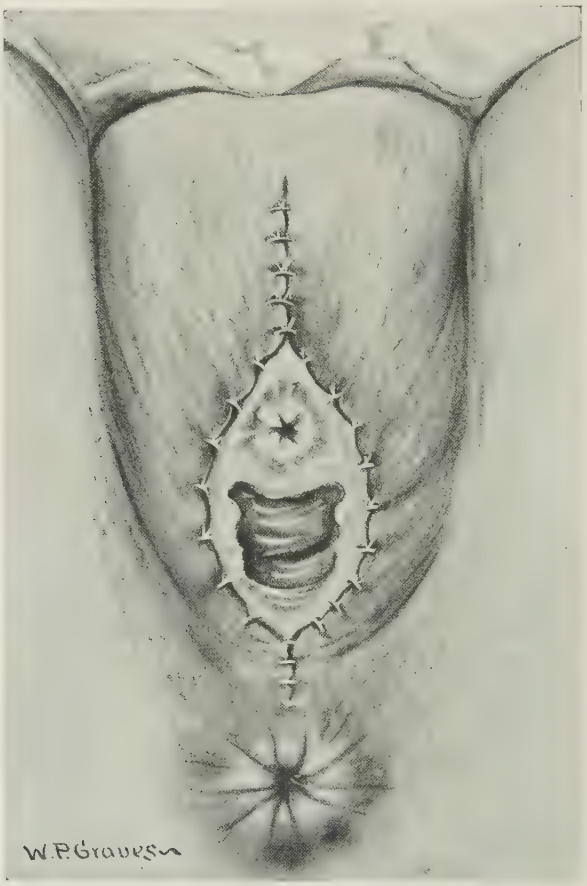


Fig. 235.—Vulvectomy.
Closure of the wound.

A second circular incision is then made about the vaginal orifice and meatus urinarius, special care being taken to leave as wide a margin about the meatus as the exigencies of the case will permit. The structures lying between these two incisions are dissected away in one piece, the depth of the incision depending on the nature of the disease for which the operation is being done. There is always considerable hemorrhage, especially in the region about the clitoris. As the vessels are apt to retract to a position troublesome to reach, it is advisable to control each spurting vessel as soon as it appears. The wound is closed in the form of a racquet, the upper edges of the outer wound being approximated

from side to side down to the point of the wound just above the meatus. At this point the edges of the outer and inner wound are approximated.

Sometimes the excision of the vulva is necessarily so extensive that various plastic maneuvers must be resorted to.

If the vaginal mucous membrane cannot easily be approximated to the edge of the skin wound, the vagina can be freed for a short distance and thus be brought down more easily.

In operating for cancer of the vulva it is often necessary to make so wide a dissection out on the skin that the method of approximation above described is not feasible. The classical plastic device for overcoming this difficulty is to make a wide triangular incision with the apex toward the thighs. The triangular area of skin included within the lines of incision is somewhat loosely attached and can easily be slid inward toward the vagina. The wound edges can then be approximated.

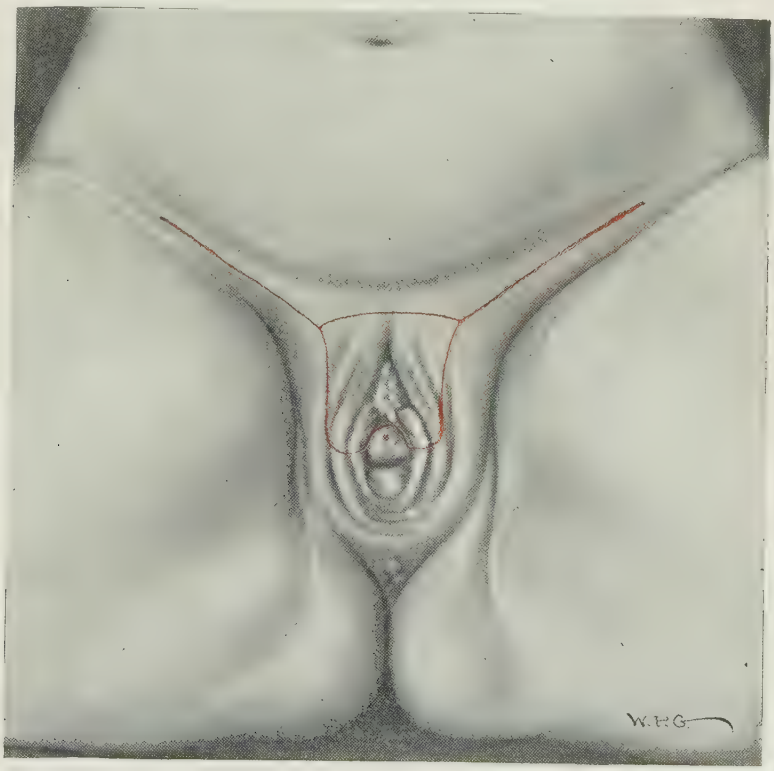


FIG. 236.—BASSET'S OPERATION FOR CANCER OF THE VULVA. THE INCISION.
Basset performs the complete operation at one sitting. We recommend Taussig's method of dissecting the inguinal regions first and performing a vulvectomy at a later operation.

## SPECIAL OPERATION FOR CANCER OF VULVA

The best method for operating on cancer of the vulva is that recommended by Taussig. He divides the operation into two stages, the first being a dissection of the two inguinal regions, and the second, performed sometime later, a removal

of the primary cancer mass. The two-stage operation is especially advisable because it is impossible to secure first intention healing from the vulvectomy wound, and if the inguinal regions have been dissected at the same time they are almost sure to be infected from the vulvar area. This results in an enormous gaping wound which requires weeks of granulation and slow healing.

The **dissection of the inguinal regions** is carried out by the Basset method. A long inguinal incision is made as in an operation for inguinal hernia, the incision being carried somewhat further toward the vulva so as to allow for wide retraction of the skin. The aponeurosis of the external oblique is divided as in a hernia operation and the round ligament exposed from the external to the

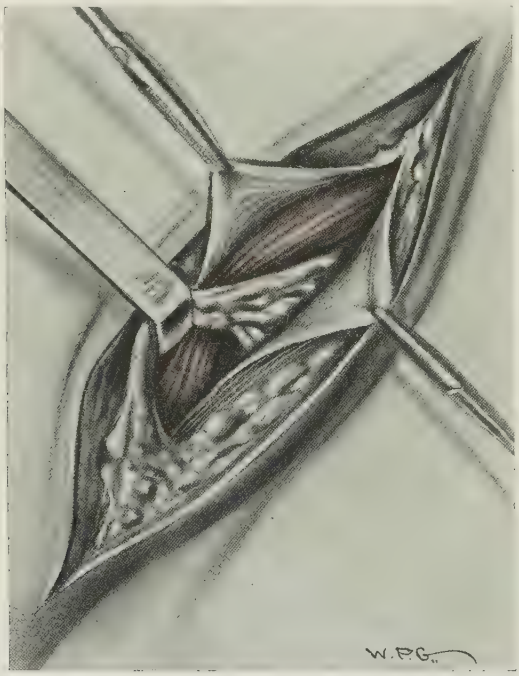

FIG. 237.—DISSECTION OF THE INGUINAL REGION FOR CANCER OF THE VULVA. The round ligament is being freed, with glandular and fatty tissue attached.

internal ring. The ligament is lifted out of its bed, care being taken that as much of the surrounding fatty and cellular tissue shall adhere to it as possible, for in this are contained the lymphatics of the so-called "upper pedicle."

When the ligament has been freed to the internal ring one sees at this point the epigastric artery and vein. The small peritoneal culdesac which surrounds the round ligament at its entrance into the peritoneal cavity is now shown. Without opening the peritoneum a retractor is inserted into this culdesac and drawn strongly upward, as in Fig. 237. This exposes the anterior part of the internal iliac fossa. All the glandular and cellular fatty tissue is then dissected away from the iliac vessels. Returning now to the inner end of the round liga-

ment (*i. e.*, at the external inguinal ring) the cellular tissue about it is carefully dissected away well down into the upper part of the labium majus. This completes the dissection of the "upper pedicle" or chain of lymphatics.

The next step is to free the lower chain. This consists in removing the cellular fatty tissue around the saphenous and femoral vessels. The lower lip of the inguinal incision is retracted downward to the upper part of Scarpa's triangle. If more room is necessary a perpendicular incision may be made extend-

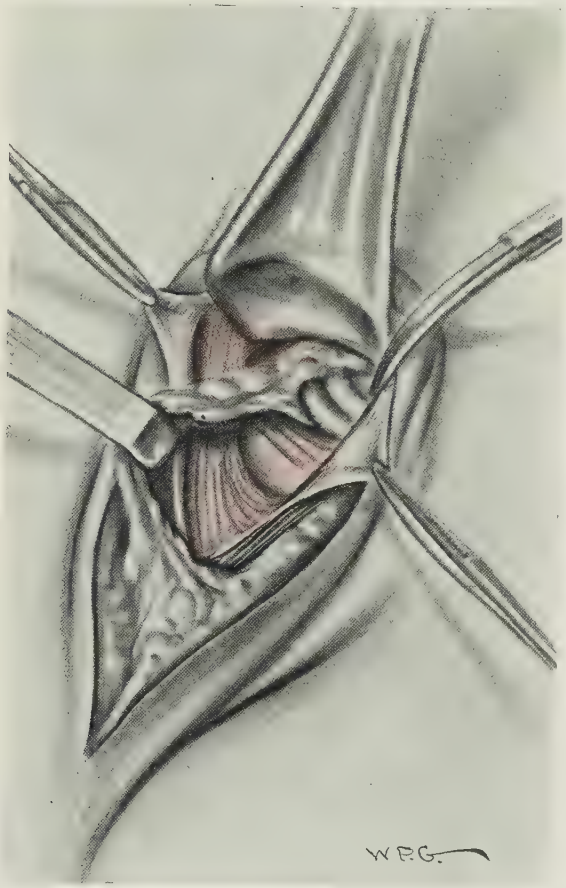

FIG. 238.—DISSECTION OF THE INGUINAL REGION FOR CANCER OF THE VULVA. Removal of the upper chain of lymphatics.

ing from the inguinal incision over Scarpa's triangle. One dissects then all the cellular tissue from the outer part of the triangle to the labium majus, completely denuding the attachments of adductor longus and pectineus muscles and the femoral vessels. If the tissues have been invaded and are voluminous it is sometimes necessary to tie and divide the saphenous vein.

The next step and one of importance is to remove the glandular tissue beneath the femoral ring. This is accomplished by cutting across Poupart's

ligament (Fig. 239) and through the femoral ring just inside the femoral vein. It may even be necessary to incise the bony attachment of Gimbernat's ligament. When the cellular tissue of this region has been thoroughly cleaned out the round ligament is then tied and cut at its point of entrance into the peritoneal cavity and the ligament removed with the entire glandular fatty mass attached. In order to make a clean dissection it is necessary to tie the deep epigastric vessels close to their point of origin.

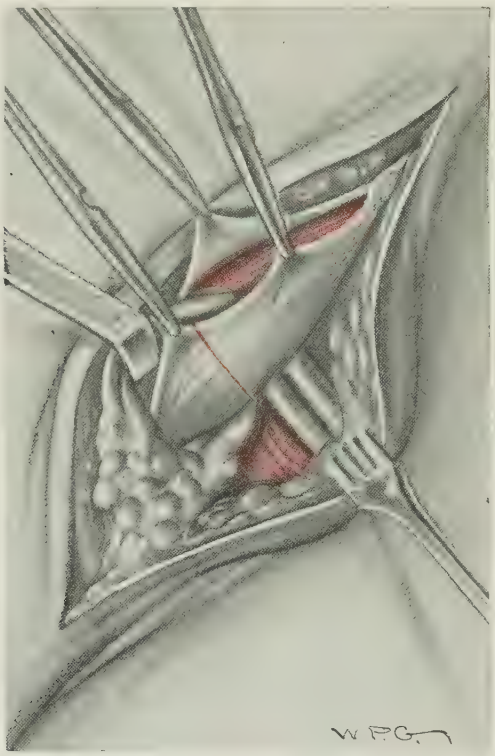

Fig. 239.—Dissection of the Inguinal Region for Cancer of the Vulva.
Exposure of the lower chain of lymphatics by lifting up Poupart's ligament. The red line indicates the direction of the incision which is to divide Poupart's ligament. Exposure of the vessels.

The final step is to restore the inguinal canal. The femoral ring is closed by suturing the internal oblique to the femoral fascia. Over this the severed ends of Poupart's ligament are sutured together.

Basset recommends leaving in a small drain leading from the deep subperitoneal space.

Both inguinal regions should be dissected in the same radical manner.

The second stage of the operation as described by Taussig is as follows:

"Two weeks later the inguinal wounds have healed, usually by first intention. We now proceed to an excision of the vulva, using neither scalpel nor scissors, but only the cautery-knife. No attempt is made afterward to close the entire

wound by a dissection of flaps. A half-dozen silkworm-gut sutures are used merely to approximate the skin edges. Thus a considerable surface is left denuded. No dressing is kept on the wound after the patient is back in bed. Under the open-air treatment with the occasional assistance of dry heat and the frequent irrigation of the vulvar wound with Dakin's solution, rapid granulation

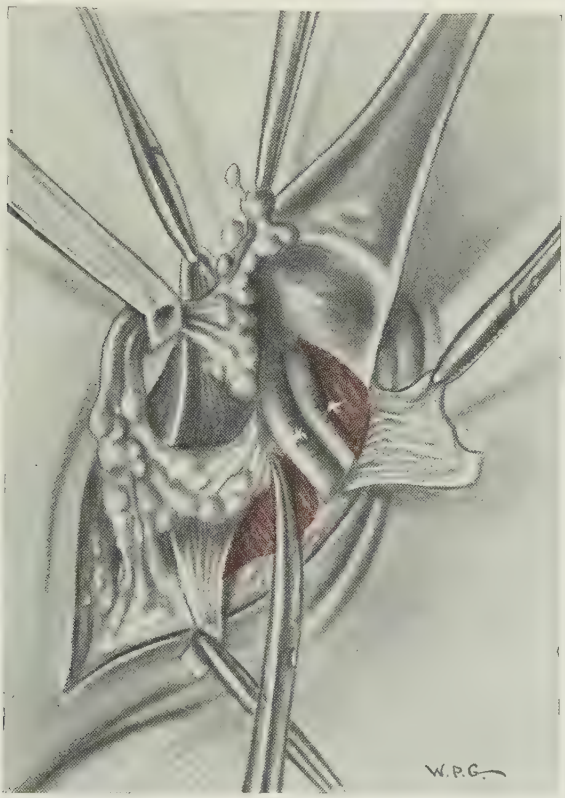


FIG. 240.—DISSECTION OF THE INGUINAL REGION FOR CANCER OF THE VULVA.
Poupart's ligament has been divided. The upper and lower chains of glands are being removed *en masse*.

is obtained and none of the necrosis and infection that otherwise is usually associated with extensive vulvar excisions appears."

## OPERATIONS ON BARTHOLIN'S GLANDS

Very acute abscesses of Bartholin's glands sometimes require incision and evacuation of the pus. The incision in this case should always be made through the skin on the outer aspect of the enlarged gland rather than through the modified membrane on the vaginal side. After subsidence of the inflammatory process the gland should always be removed by a radical dissection, as otherwise it is almost sure to give trouble later, either as a recurrent abscess or in the form of a cyst. Many of the abscesses of Bartholin's glands when the in-

flammatory process is not violently acute can be excised without preliminary incision, the decision as to this point being determined by the amount of infiltration or involvement of the surrounding tissues.

Cysts of Bartholin's glands, even when small, should always be radically excised, otherwise they are sure to recur.

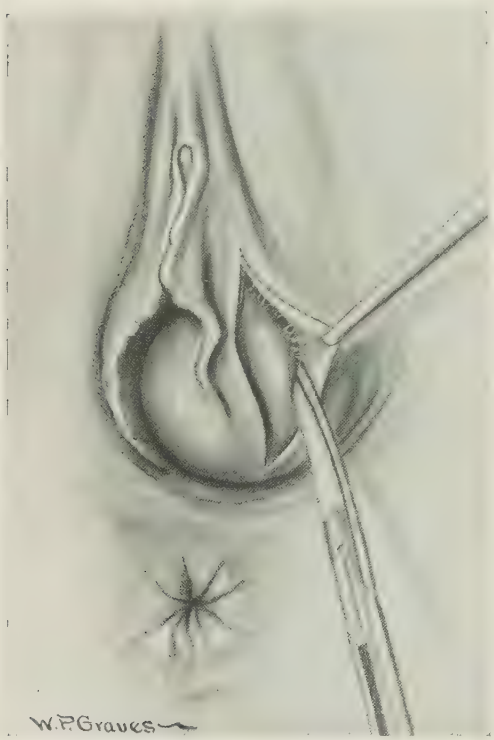


FIG. 241.—DISSECTION OF BARTHOLIN'S GLAND FOR CYST OR ABSCESS.

The incision is made through the skin *outside* of the labium minus. The cystic gland is dissected out entire with blunt-pointed scissors. In order to avoid rupturing the cyst the dissection is carried out on the outer side first, the region of the duct being dissected last.

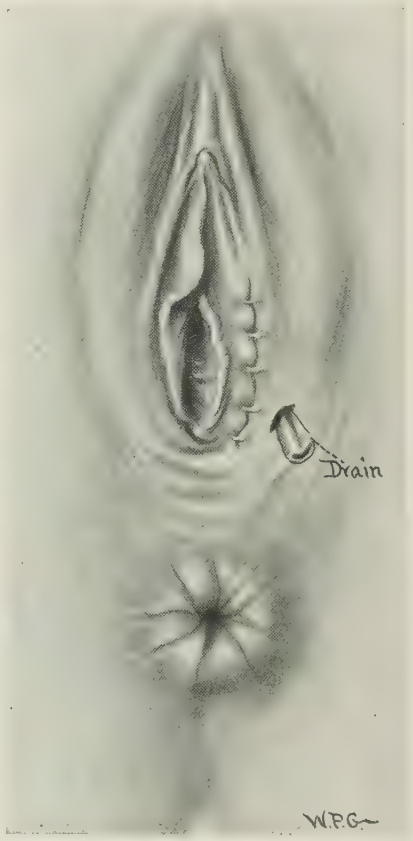


FIG. 242.— EXCISON OF BARTHOLIN'S GLAND.

The wound external to the labium minus is closed with deep silkworm-gut sutures. A small rubber drain is placed through a stab-wound, to be removed in thirty-six to forty-eight hours, or later if an abscess has been exsected.

The complete operations for both abscess and cyst are practically identical. The patient should be fully anesthetized, for the dissection must always be carried deeply into the tissues, and there is, as a rule, troublesome bleeding. The incision is made on the outer surface of the swelling through the skin. An attempt is then made to dissect out the capsule of the abscess or cyst, the outer portion embedded beneath the skin being treated first. The dissection is gradually brought around toward the inner side, where it becomes more diffi-

cult on account of the adherence of the thin membrane of the inner side of the labium minus. The area of the duct is approached last, and as the dissection is carried across this portion the tumor usually collapses and discharges its contents. It is not always possible to enucleate the entire tumor without rupturing the capsule before crossing the duct; nevertheless, if this can be done, the results of the operation are much more satisfactory. If the capsule has collapsed it must be removed from the depth of the wound in ragged shreds, remnants of which if left behind are liable to be the source of a future recurrence.

In dissecting out a fresh gonorrheal abscess it should be remembered that the pus is often under considerable tension. If the abscess is accidentally ruptured the eyes of the operator, which are necessarily in a position near the field of operation, are in much danger of infection from the spurting pus.

Before closing the wound great care should be taken to stop all the hemorrhage with ligatures of fine catgut. If the bleeding cannot be controlled in this way, deep sutures may be taken in the bleeding tissues. The dead space left by removal of the tumor is closed for the most part by buried deep sutures. A small drain of folded rubber tissue is left in the bed of the wound leading to a small stab-wound to one side of and below the original incision. The main wound is closed with silkworm-gut sutures deeply placed, the ends of which are shotted.

## OPERATIONS ON THE CERVIX

### DILATATION OF THE CERVIX

DILATATION of the cervical canal is performed as a therapeutic measure for sterility and dysmenorrhea, and as a preliminary step to curetage of the body of the uterus and repair of the cervix.

With the patient in the perineal position, the anterior lip of the cervix is grasped in the middle by a pair of double hooks (or bullet forceps). Enough tissue should be included in the double hooks to prevent their tearing out and causing a laceration.

The best instrument is that devised by Cullen, the hooks of which are mouse-toothed, and by their firmer hold on the tissues cause less tearing than do the ordinary so-called bullet forceps.

The cervix is drawn gently down toward the vaginal introitus. Strong traction should be avoided. Dilatation of the non-pregnant uterus is most safely carried out with Hanks' graduated dilators. It is best if possible to secure a set of old-fashioned dilators which have a short thrust with only a slight angle. (The dilators usually sold are too long and too sharply bent.) The first dilator should be passed with extreme care in all cases, for deviations or angulations of the canal, or obstructions from stenosis or growths, may deflect the point of the instrument into and through the uterine tissue. In certain conditions of atony of the uterus, more especially such as exist after the menopause or during gestation, an instrument may perforate the uterine wall with almost inappreciable resistance.

If the first dilator does not discover the direction of the canal at once, a fine probe should be used. When the direction of the canal has been established the successive sizes of the dilators are used until the last has been passed. If greater or more prolonged dilatation is desired, as in the treatment of dysmenorrhea and sterility or of retained products of conception, Goodell dilators may then be used. These must be handled with care, as it is an easy matter to split the side of the cervix with them and cause a dangerous hemorrhage. If the dilatation is being done for exploration or curetage of the endometrium, it need not be carried beyond the passage of the largest Hanks' dilator.

The next step is to ascertain the depth of the uterus, and this is done with a measured uterine sound. This is also a dangerous instrument, and one which most often is responsible for perforation of the uterine wall. In order to avoid this accident the sound before being passed should be bent to the same angle as the dilators. In passing it no more pressure should be exerted than is made by the friction of resting it on the forefinger.

Sometimes a cervix is difficult to dilate, as occurs, for example, in the hypoplastic anteflexed type of uterus, where there is a dense band of connective tissue at the internal os. The difficulty of passing the sound must be met by strong countertraction on the double hooks in the anterior lip of the cervix, and may result in lacerating the tissue. If such a laceration occurs it should be repaired with fine catgut, for if neglected the wound may become infected and cause a long-standing and intractable cervicitis. In order to avoid the accident of lacerating the cervical lip when it is found that the dilatation is going to be difficult, two pairs of double hooks may be used inserted each on one side of the cervix. If laceration takes places less injury is done, as the wound does not communicate with the mucous membrane.

## CURETAGE

Since our knowledge of the physiologic and pathologic processes of the uterine mucosa has been put on a new scientific basis the use of the curet is much less frequent than formerly.

As a curative agent, its principal function is for the removal of products of conception that cannot be extracted in any other way, and occasionally in some cases of hypertrophy or chronic inflammation of the endometrium and for chronic endocervicitis.

Its chief use is for the removal of endometrial tissue for the purpose of microscopic examination.

After dilatation of the cervix and passage of the sound to determine the depth of the uterus, it is best to explore the uterine canal next with a pair of placenta forceps. These can now be used safely because the direction and depth of the canal is known. The object of the placenta forceps is to discover and remove polypoid growths which may escape detection with the curet.

The curet is passed into the canal in the same manner as that described for the sound. It should not be bent at an angle sharper than that of the dilators unless it is being used to remove some resistant material like that of adherent placental tissue. If the object of the curetage is the removal of hypertrophic mucosa the entire uterine canal is thoroughly scraped with a sharp curet until everywhere the sharp scratch of the submucosa, the so-called *cri uterine*, can be heard. Each time the curet is carried into the uterine canal it should be passed lightly on the finger, but it may be drawn out vigorously.

If the object of the curetment is the removal of fetal tissue, it is best to use a blunt wire curet, especially if the retained tissues are infected. The deep scarification of the uterine canal, under such circumstances, may carry the infection into fresh lymph-channels and encourage or set up a dangerous puerperal infection. If in the case of retained products of conception it is difficult to remove all the contents of the uterus, it is better not to err on the side of being too thorough, for the danger of perforating the uterus or of spreading infection

is greater than that of leaving in portions of fetal tissue, which are usually expelled spontaneously. This may occasionally require a later curetment, when the uterus is less liable to infection or perforation.

When the curetage is being employed for diagnosis a small sharp curet is used, which explores every part of the uterine canal. If the tissue removed is suggestive of malignancy, the curet is purposely carried deep into the uterine wall in order to be able to tell by microscopic examination whether or not the disease has invaded the myometrium. In curcting for diagnosis the placenta forceps must always be used in order not to miss any polypoid growths.

Curetage of the cervix for endocervicitis should be done with a small, very sharp curet, and the cureting should be confined to the cervical canal, for if the fundus is included there is danger of spreading the infection of the endocervical glands.

After cureting the endometrium no further treatment is usually necessary, it being important to avoid intra-uterine douches and chemical applications. If there is severe bleeding, it may, under rare circumstances, be necessary to pack the uterus with sterile gauze, though such bleeding can usually be controlled by packing the vagina tightly against the uterine vessels.

If it seems likely that bits of tissue have been left in the uterine cavity, these may be wiped out with a strip of gauze carried, preferably, on a Burrage tampon extractor. It should be remembered, however, that the uterus is frequently perforated by this wiping-out process.

Curetment for cancer of the cervix is best done with a large, comparatively sharp curet, which, however, must be used with great care when in proximity to the bladder or posterior culdesac, or the uterine vessels.

Cases for curetage should always be subjected to a thorough surgical preparation, and should, with few exceptions, be anesthetized. If patients are properly prepared, and the operation done under antiseptic precautions, simple puncture of the uterus ordinarily does no harm, and it is usually not necessary to sew up the wound through a laparatomy incision. The patient should, however, be watched carefully for possible hemorrhage.

Larger wounds, such as are made by the curet or placenta forceps, especially in removing fetal tissue, may allow the gut to prolapse into the uterine canal.

Perforation of the posterior culdesac made while cureting cancer of the cervix is almost inevitably followed by fatal peritonitis.

## TRACHELOPLASTY

Repair of the cervix is indicated in conditions of erosion, eversion, and inflammation, and is intended to restore the organ as nearly as possible to its normal appearance and tissue condition. Most operations for repair of the cervix are based on the operation originally suggested by Emmet. The technic of the operation is as follows:

With the patient in the perineal position, dilatation of the cervix is first performed in order to make the tissue softer and more pliable and to give more room for the passage of ligatures. The anterior and posterior lips of the cervix are grasped each with double hooks placed *exactly in the middle line,* as indicated by the central raphé, from which radiate the branching folds of the cervical mucosa (arbor vitæ). The double hooks are then brought closely together so as to approximate the two cervical lips. In cases of laceration this gives an accurate idea as to whether the cervix has been torn on one or both sides. It is somewhat more common to find that the tear is *unilateral,* and that the repair need be carried out only on one side.

This point is emphasized because the beginner is apt to place the traction forceps midway between the ends of the tear and denude on each side of the forceps, instead of placing the forceps in the midline of the cervix and denuding only where the tear indicates. If the latter method of technic is not carried out the operation will result in a crooked canal which is apt later to cause either an atresia of the lumen or a fistulous opening in one end of the wound.

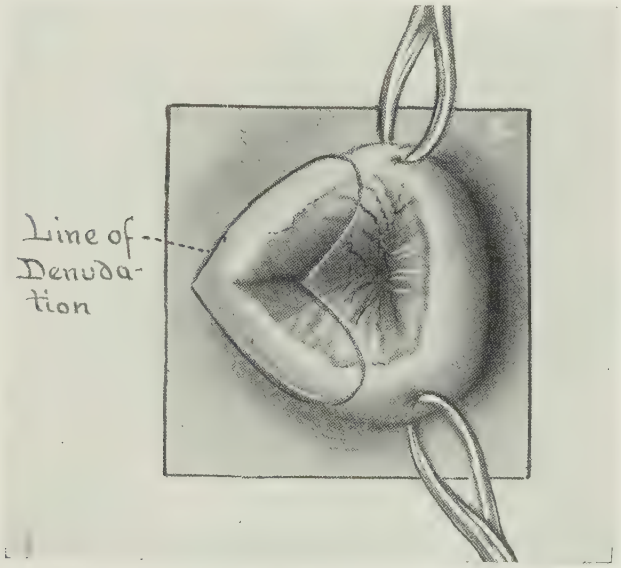


FIG. 243.—TRACHELOPLASTY. UNILATERAL TEAR.
Heart-shaped outline of the area to be denuded.

When the location of the tear or tears has been definitely made, the limit of the denudation at the os is marked with the scalpel on one or both sides of the traction forceps. In marking these points it must be borne in mind that the exit of the new canal must be funnel shaped, so that it is better to err on the side of getting it too wide than too narrow, otherwise there is danger of atresia in later life when the cervix becomes atrophied.

These important landmarks having been made, the lips of the cervix are drawn widely apart and the area of denudation outlined with the scalpel. This area simply includes the sides and angle of the laceration (Fig. 243). The

outside edge is a continuous line from the mark on the anterior lip to that of the posterior lip in the smooth vaginal portion of the cervical membrane; the inside edge constitutes a line between points in the rough endocervical mucous membrane. The width of the denudation area is usually about $\frac{3}{8}$ inch, corresponding to the natural thickness of the cervical wall. It is important that the figure of denudation be symmetrically drawn on the two lips, so that when they are approximated for suture there will be perfect coaptation of the wound edges. The denudation of the marked-out area is made with a small scalpel,

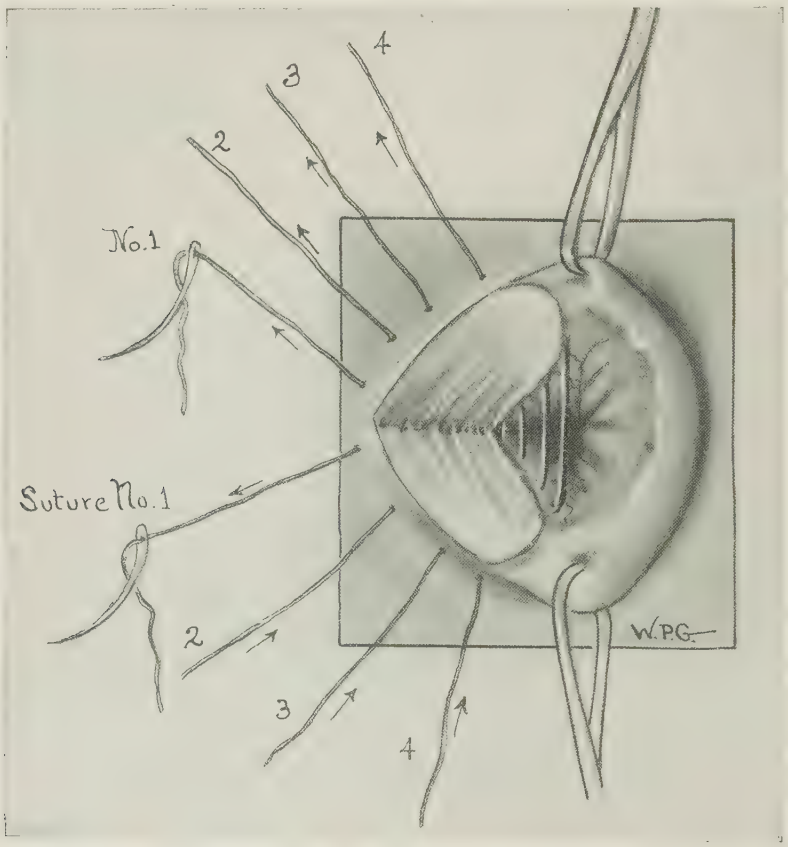


Fig. 244.—Trachelorrhaphy.
Unilateral denudation of cervix and placing of stitches.

beginning from the mucous membrane, and should be carried out so that the tissue to be removed from both lips and the angle between them is taken off in one piece. If there is a great deal of scar-tissue beneath the denuded surface it may be dissected out in small wedge-shaped pieces.

When the laceration is deep, denudation of the angle usually causes some bleeding from the cervical artery. This should be controlled by a ligature passed into the tissue with a needle before the stitches are placed, for if this bleeding is neglected it may give trouble during the convalescence, sometimes

requiring a secondary operation. If there are several lacerations, they should be denuded before putting in the stitches.

The placing of the sutures may cause considerable embarrassment on the part of the operator if the laceration is a deep one, or if the cervix cannot be drawn well down to the introitus. This difficulty may, however, always be avoided by the proper use of special needles.

The best needle is that originally devised by Emmet. It has a slight curve, and can be forced through the tough fibrous tissue of the cervix without danger of breaking, an accident which may be very troublesome.

The placing of the first suture is the most important. If the angle is difficult to reach, it is best to use a "double header" suture—*i. e.*, one with a needle on each end. The first needle is passed from within outward on one lip, so that it will issue well beyond the angle of denudation (Fig. 244). The other needle

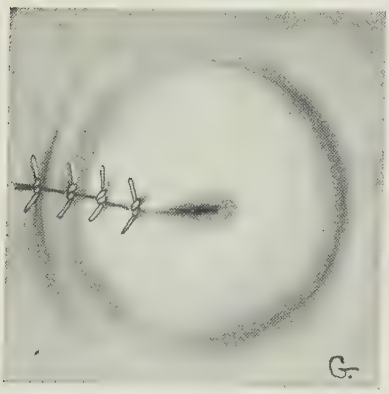

FIG. 245.—UNILATERAL TRACHELOPLASTY COMPLETED.

FIG. 246.—LACERATED CERVIX WITH ONE LIP LONGER THAN THE OTHER.

is then passed in a similar way in the other lip, and the two ends are fastened in a clamp. By passing the suture in this way no difficulty is encountered, and it is placed so high beyond the angle that when tied it serves to control any cervical vessels that might otherwise bleed later. The other sutures are then placed in like manner, the "double header" no longer being necessary after the first one or two stitches. It is best to clamp the ends of the sutures without tying until they have all been placed. Sutures are then placed on the denuded area of the other side if a double laceration is present. When all the sutures are in place the traction forceps are removed and the sutures tied. The best suture material is No. 1 chromicized catgut.

Not infrequently one lip, usually the anterior, is longer than the other, so that the denuded areas do not match when approximated (Fig. 246). If the difference in length is only slight, the difficulty may be obviated by placing a tenaculum in the side of the longer lip, a short distance from the angle of denudation, and drawing it sharply outward. This creates a new angle and makes the two lips of equal length. One lip, however, may be so much longer than the other that this maneuver will not suffice to make their length

equal. In this case the end of the longer lip may be amputated by a wedge-shaped incision and the edges sewed with catgut. In this way the lips are easily made of equal length.

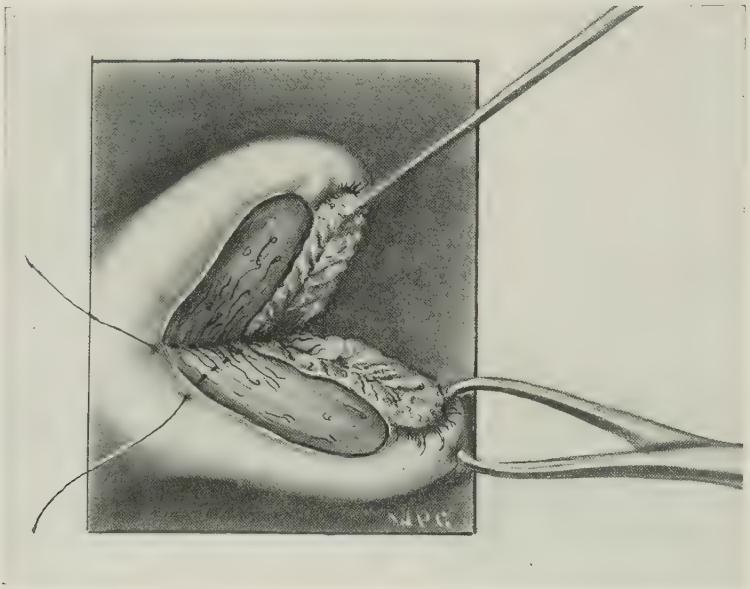

FIG. 247.—TRACHELOPLASTY.

Method of creating a new angle when one lip is longer than the other. If this cannot be done on account of the stiffness of the tissues, a wedge-shaped piece may be removed from the end of the longer lip.

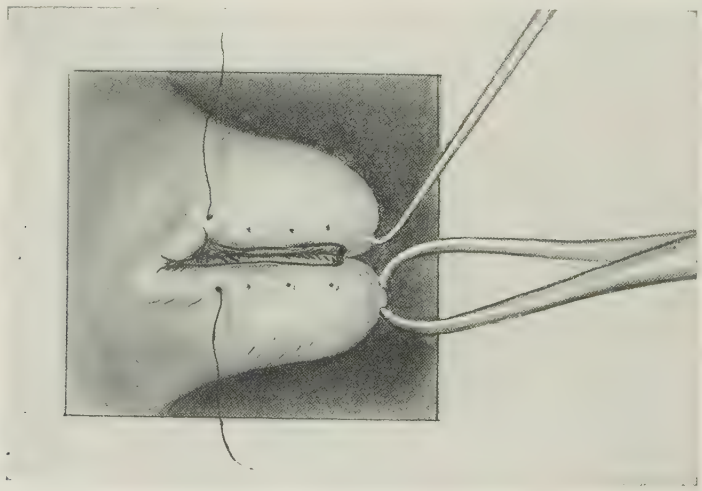

FIG. 248.—TRACHELOPLASTY.

Creating a new angle when one lip is longer than the other.

When the hypertrophy and elongation of one lip is very marked the preceding operation is not sufficient to equalize the two lips. It is then necessary to amputate the elongated lip. This is done by removing it by a wedge-shaped incision (Fig. 249). The edges of the wound may then be easily approximated by a few

interrupted catgut sutures (Fig. 250). When the amputation wound has been closed the two lips are equal in length and the operation for the laceration is carried out as in the ordinary case.

Sometimes the hypertrophy of the submucous connective tissue along the center of the canal is so great that the denjded areas of the sides cannot be approximated without too great tension on the stitches (Fig. 252). To obviate

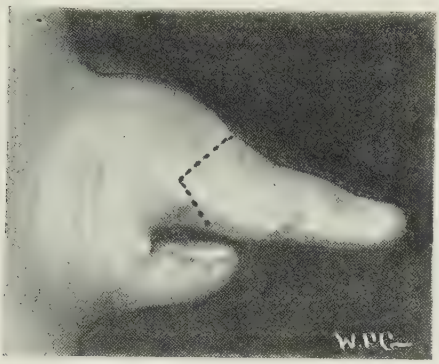


FIG. 249.—TRACHELOPLASTY.
Amputation of an elongated lip.

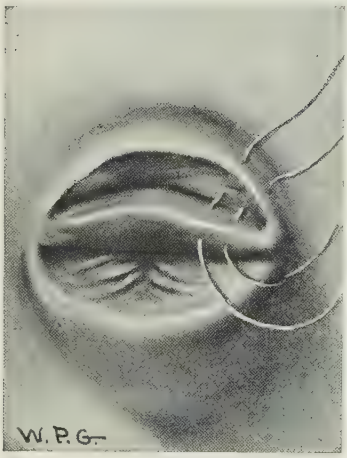


FIG. 250.—TRACHELOPLASTY.
Amputation of an elongated lip. Closure of wound.

FIG. 251.—TRACHELOPLASTY.
Amputation of an elongated lip. Closure of wound.

this a transverse wedge may be removed from one or both lips, and the edges of the mucous membrane sewed with catgut (Figs. 253, 254). When this is done it will be found that the denuded areas can be approximated without difficulty.

When the tear is stellate there are more than two lacerations and the repair looks somewhat complicated. By sewing up each tear as above no great difficulty is encountered. a smooth result depending on the ingenuity of the operator.

FIG. 252.—ECTROPION OF THE CERVICAL MUCOUS MEMBRANE AFTER A SEVERE BILATERAL LACERATION.

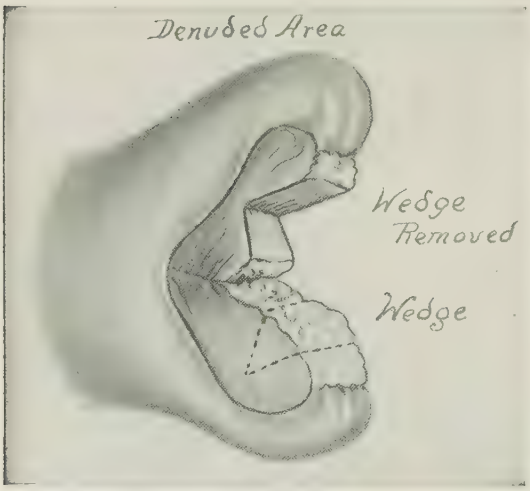


FIG. 253.—TRACHELOPLASTY.
Removal of wedge-shaped piece from the everted mucous membrane. (Baker's method.)

FIG. 254.—TRACHELOPLASTY.
Baker's method of reducing redundant and everted mucous membrane by the removal of wedges.

## AMPUTATION OF THE CERVIX

The chief indication for amputation of the cervix is in procidentia, where the cervix is usually elongated and attenuated.

The operation of amputation should not be preceded by dilatation, a procedure which so stretches and thins out the canal that it is difficult to avoid tearing into it in the process of stripping out the cervix. A sound is first passed to determine the depth of the uterus and cervix and to ascertain approximately the level of the internal os. A sound is then passed through the urethra into the bladder fold, where it is reflected from the cervix. This fold is usually found on the anterior wall of the cervix very near the external os, and a knowledge of its exact position is very important.

Traction hooks are then placed one at each corner of the tear and one in the middle of the cervix, including both lips and sealing the opening, so as to avoid the expulsion of any endocervical discharge during the operation.

With the cervix held out in strong traction a circular incision is made just beyond the reflection of the bladder fold. The assistant exercises counter-traction on the vaginal mucous membrane, and the circular dissection is carried out with a knife until the small tubular core of the cervix is reached, great care

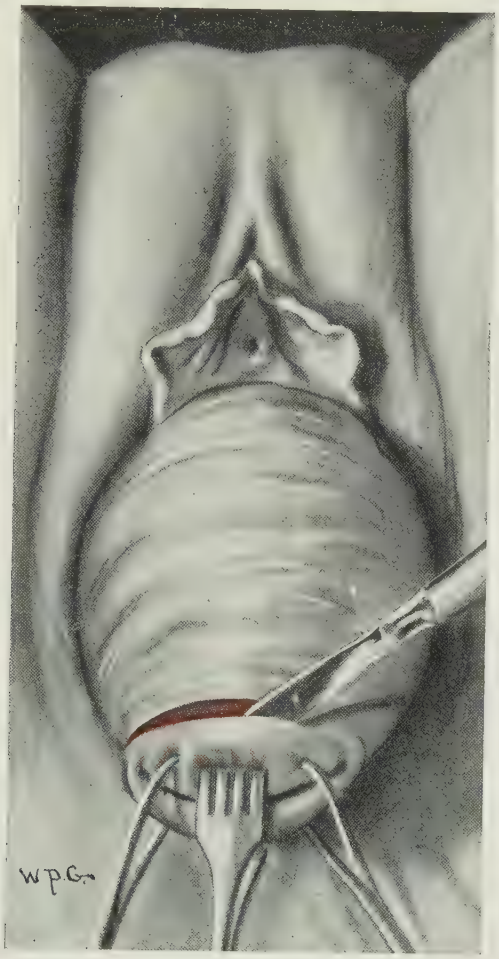


FIG. 255.—AMPUTATION OF THE CERVIX.
The cervix has been drawn well out from the vagina. The cervix is being circumcised at the junction of the bladder with the portio vaginalis.

being taken not to injure the bladder fold. The fold of Douglas' pouch on the posterior wall of the cervix is usually not in danger in this dissection, as it is attached higher up than the bladder. After the core of cervix is reached it will be found that the tissue of the uterine wall can easily be stripped back from it by gauze dissection (Fig. 255), the knife being occasionally necessary to sever

especially resistant connective-tissue fibers. This dissection is carried to within a short distance of the internal os, as determined by the length of the cervix previously ascertained. The two traction forceps are then inserted in the sides of the cervical tube close to the limit of the dissection, and held by the assistants. The cervix is drawn strongly outward by the remaining traction forceps and the

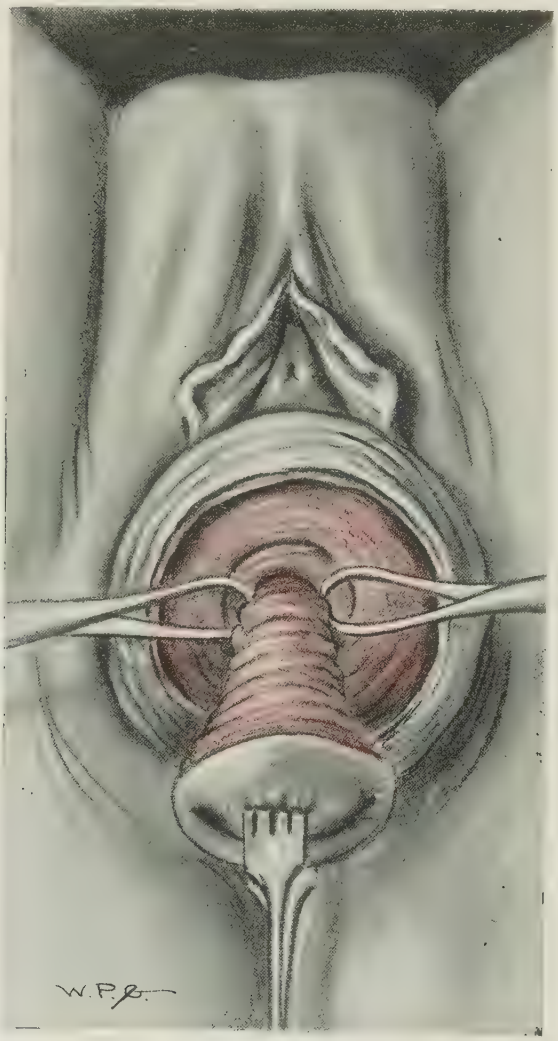

Fig. 256.—Amputation of the Cervix.
The elongated cone-like cervix has been stripped out of its bed and is now ready for amputation.

tubular core is amputated by a wedge-shaped incision, so that the uterine portion will be convex. This is an important maneuver, because it leaves a convenient stump for the insertion of stitches through the cervical mucous membrane—the stump being held forward by the two traction forceps. If this precaution is not taken, the cervical mucous membrane will retract sharply

back, and be so hidden from view that it is difficult to place sutures in it. During the dissection the bleeding may be little or great, depending on the amount of congestion in the individual case. The bleeding points are now tied, preferably with No. 0 catgut.

The placing of the sutures should be carried out with great precision, for it is to the exact approximation of the wound edges that the operation owes its

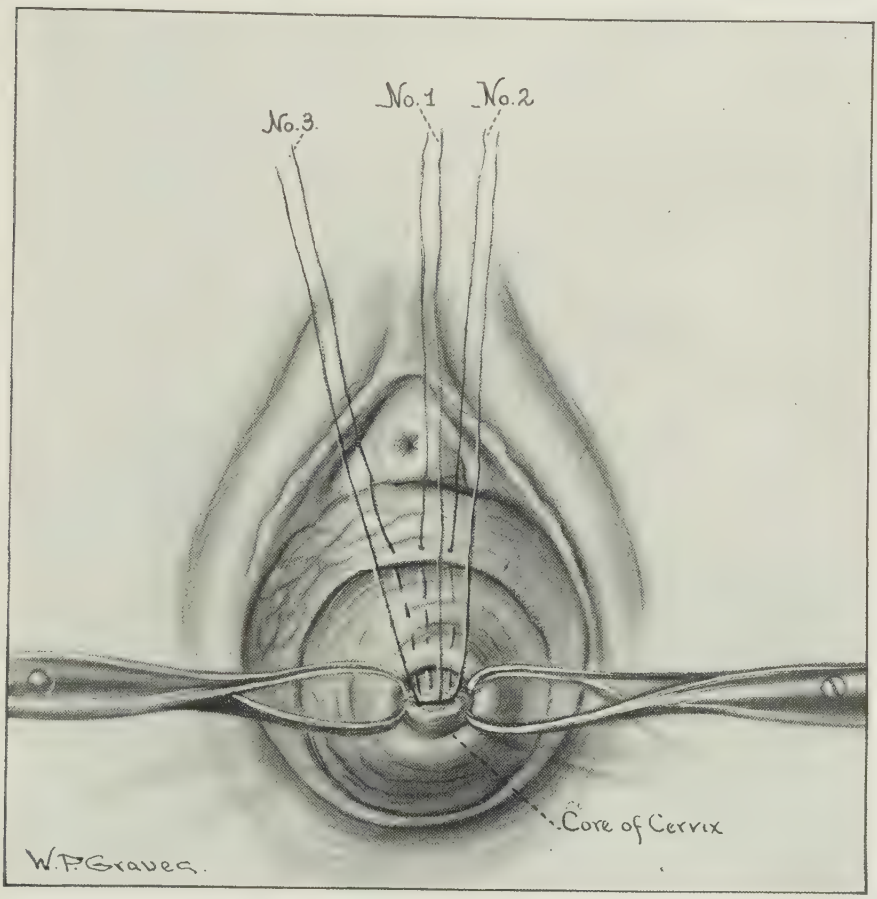


FIG. 257.—AMPUTATION OF THE CERVIX.

The cervix has been amputated so that the stump juts from the surrounding tissue in the form of a wedge. Three sutures have been introduced into the anterior lip of the cervical stump and continued to the vaginal mucous membrane, taking in a little of the intervening tissue. Three other corresponding sutures are next passed through the posterior cervical wall in the same way. By the tying of these six sutures the mucous membrane of the cervical canal and that of the vagina are exactly approximated. (See Fig. 259.)

success. Inaccurate coaptation almost invariably results in local sepsis, with sometimes a very marked constitutional reaction.

The cervical stump is held in the middle line by the traction forceps. Three sutures are placed through the anterior lip of the cervical stump including the mucous membrane, and carried to the anterior edge of the vaginal flap (Fig. 257).

Three sutures are then passed through the posterior lip of the cervical lip to the posterior edge of the vaginal flap. Next a suture is passed from the anterior vaginal flap across, including the left cervical angle, and issuing from the posterior flap at a point directly opposite to that from which it started. The ends of the suture are clamped and drawn strongly to the right, the traction forceps being removed (Fig. 258). A long-pointed tenaculum is then inserted in the edge of the vaginal flap at a point exactly between the entrance and exit of the last placed cross-suture and drawn strongly outward. Cross-sutures are

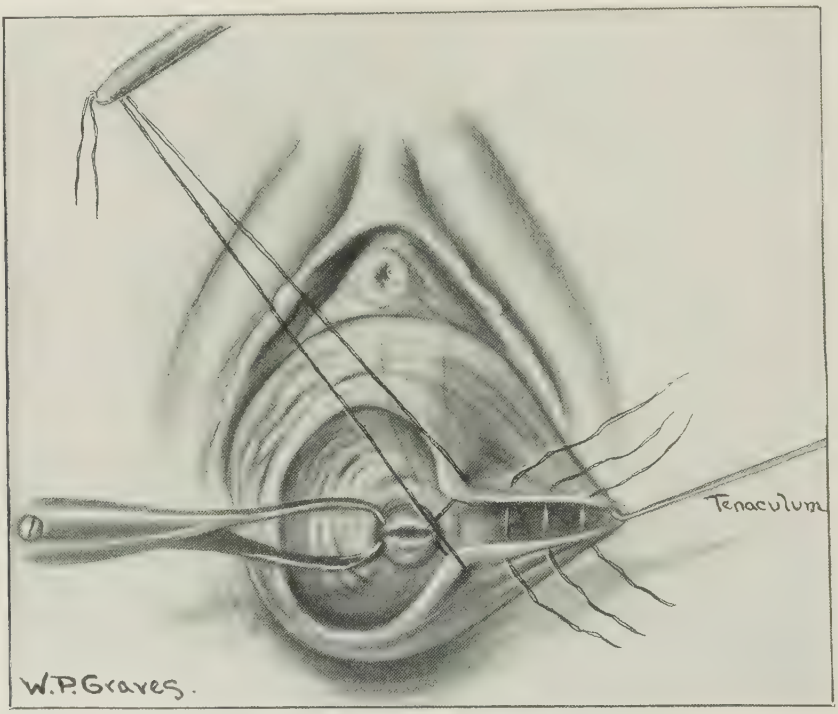


Fig. 258.—Amputation of the Cervix.

Manner of introducing the lateral sutures so as to secure exact approximation. The first suture is drawn sharply to the opposite side and a tenaculum placed in the angle of the vaginal wound. The sutures can then be accurately introduced, so as to avoid any puckering or clumsy coaptation of the wound edges. The sutures uniting the mucous membrane of the cervix and that of the vagina (as in Fig. 257), though applied first, are omitted in this drawing for the sake of clearer illustration.

now placed from the anterior to the posterior flap, each one including some of the loose paracervical tissue to avoid leaving a dead space. The same procedure is then carried out on the other side of the cervical stump. When the stitches are tied it will be found that exact coaptation has been secured. By employing this technic sepsis will rarely occur and scar formation or atresia of the canal need not be feared.

The operation just described is a high amputation of the cervix. Low amputation is done in the same way for removal of the cervix when not elongated, the dissection being carried up only a short distance.

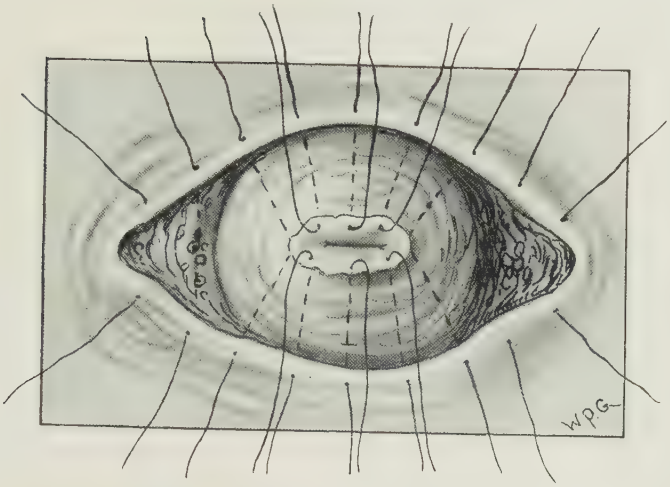


FIG. 259.—AMPUTATION OF THE CERVIX.
Hegar's method, showing the manner in which the approximation sutures are introduced. The sutures on each side are passed deeply into the paracervical tissue so as to assist in controlling hemorrhage, the most important blood-vessels lying in these areas.

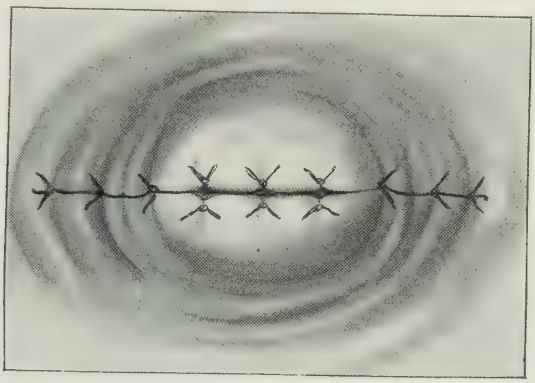

FIG. 260.—AMPUTATION OF THE CERVIX.
Sutures tied and operation finished.

## SCHRÖDER'S OPERATION

Schröder's operation is used for intractable endocervicitis, and is designed for the complete removal of the endocervical mucous membrane.

The cervix is first seized with two pairs of double hooks or traction forceps, one on each lip of the cervix, and drawn down to the vaginal introitus. The cervix is then split on each side with the scalpel, the incision being carried well up toward the internal os, in a manner simulating a deep bilateral laceration. Bleeding points are clamped and tied. The lips are then held widely apart by the traction forceps. From each lip a transverse wedge-shaped piece is taken, including all the mucous membrane excepting a narrow margin near the internal os, into which sutures can be placed. The shape of the wedge of tissue to be

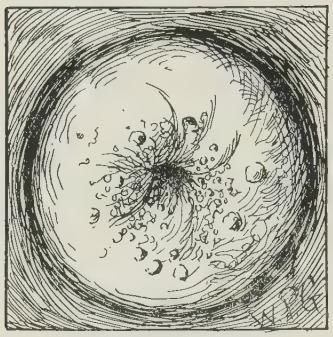

Fig. 261.—Cervicitis and Endocervicitis, with Formation of Nabothian Cysts.

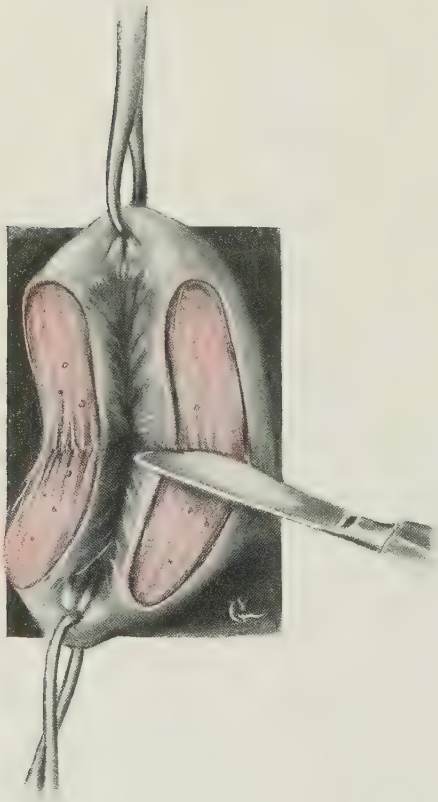

Fig. 262.—Schröder's Operation for Extirpation of the Endocervix.

First step. The cervix is being cut bilaterally to the level of the internal os.

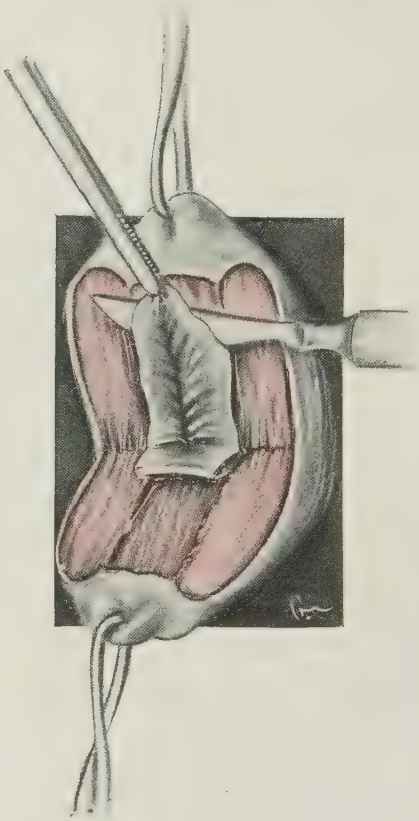

Fig. 263.—Schröder's Operation for Extirpation of the Endocervix.

The bilateral incision has been made. The mucous membrane of the posterior lip has been removed and the mucous membrane of the anterior lip is being dissected in the same manner.

removed will be understood by reference to Fig. 263. The cervical mucous membrane of the vaginal portion of each lip is approximated to the margin of

endocervical mucous membrane by two catgut sutures. In approximating these edges the lips are folded in on themselves, so that the cervical canal is now

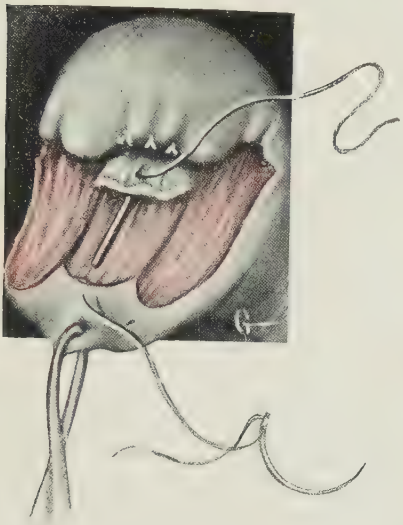

FIG. 264.—SCHRÖDER'S OPERATION FOR EXTIRPATION OF THE ENDOCERVIX.

The mucosa has been removed from both lips. On the anterior lip the mucous membrane of the cervical canal has been united to that of the portio by three sutures. The same process is being repeated on the posterior lip, the middle suture having been passed.

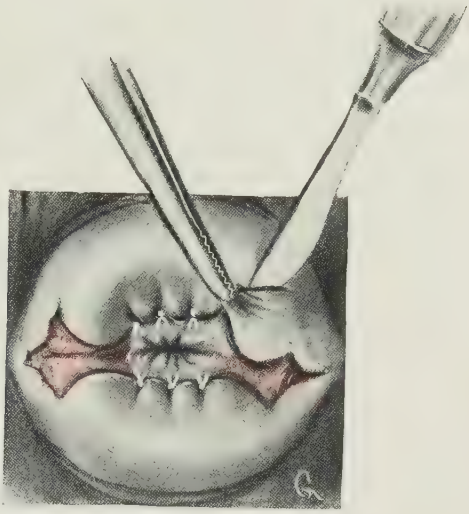

FIG. 265.—SCHRÖDER'S OPERATION FOR EXTIRPATION OF THE ENDOCERVIX.

The mucosa has been removed and the approximation of the cut edge of the cervical mucous membrane to that of the portio has been secured by the sutures on each lip. The angles are being denuded, the rest of the operation being carried out exactly as an Emmet's tracheloplasty.

lined with the epithelial surface of the vaginal portion. Before tying the sutures the traction forceps must be removed, but the cervix may be still held

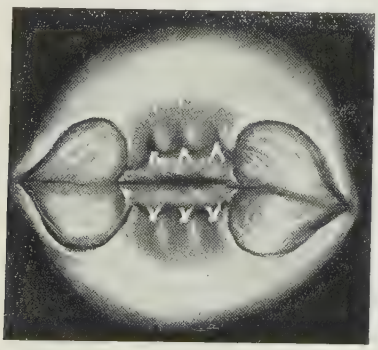

FIG. 266.—SCHRÖDER'S OPERATION.
Angles ready for suture.

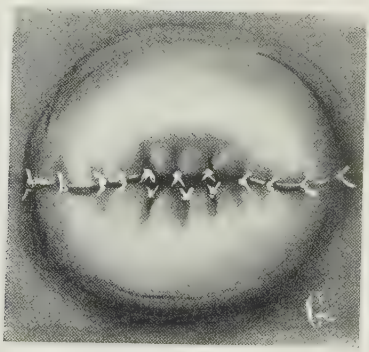

FIG. 267.—SCHRÖDER'S OPERATION COMPLETED.

down by applying one of them to the anterior wall of the cervix sufficiently high to avoid exerting any tension on the stitches. When the anterior and posterior walls have been folded in and the stitches tied it will be found that

the cut surfaces on the sides of the cervix now present the appearance seen when a bilateral laceration has been denuded and ready for the placing of the sutures. The sutures are then placed in the manner described for a tracheloplasty.

In passing the sutures which fold in the cervical lips a small full-curved needle should be employed, and great care should be exercised to avoid tearing through the endocervical mucous membrane, for if this happens it is difficult afterward to place the stitch so that it will hold securely. The success of the operation depends very largely on the skilful placing of these mucous membrane sutures, for if they give way the result is a long and cicatricial process of healing.

Schröder's operation is a radical but almost certain cure for endocervicitis, but it is difficult of performance and should not be attempted except by those experienced in plastic surgery, for if improperly done the result is a troublesome mutilation of the cervix.

### STURMDORF OPERATION FOR CHRONIC ENDOCERVICITIS

The following operation was devised by Dr. Arnold Sturmdorf with the purpose of removing not only the glandular tissue of the cervix but also the surrounding infected area in case of chronic endocervicitis. Sturmdorf recom-

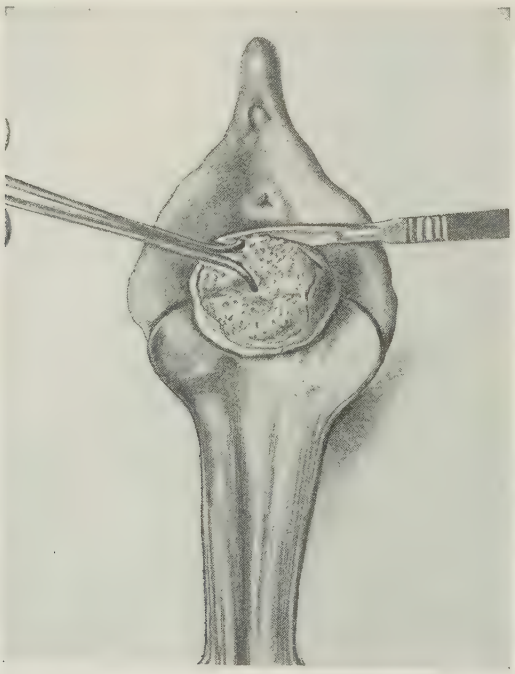

FIG. 268.—STURMDORF'S OPERATION.
Outlining vaginal cuff at the line of demarcation between vaginal and diseased cervical mucosa (after Sturmdorf).

mends it not only for simple endocervicitis, but also as a substitute for Emmet's tracheloplasty in treating lacerated cervices with secondary chronic inflamma-

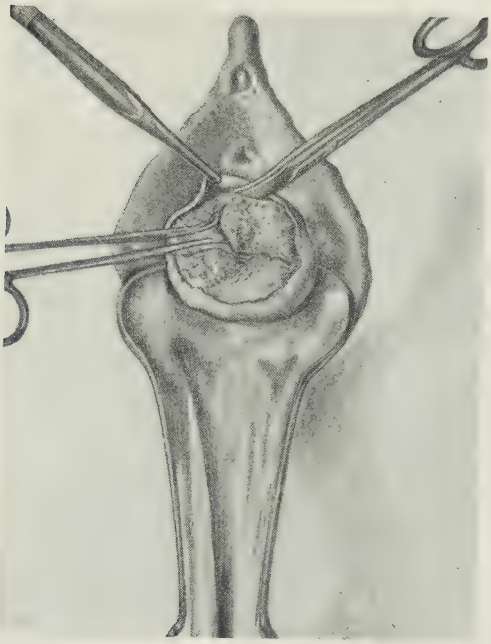

FIG. 269.—STURMDORF'S OPERATION.

Stripping back vaginal cuff. This should be carried back to level of internal os even if it is necessary to push back the bladder (after Sturmdorf).

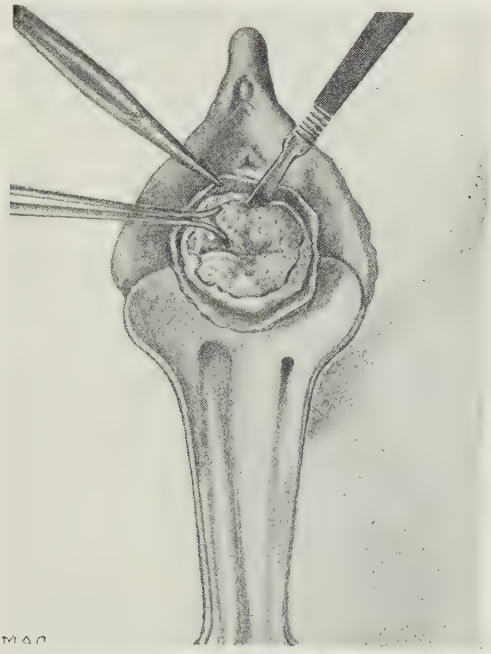

FIG. 270.—STURMDORF'S OPERATION.

Coring out cervical mucosa, leaving shell of cervical muscularis (after Sturmdorf).

tion. This operation has the advantage over Schröder's operation in that it is easier to perform and ensures a better chance of healing between the edges of the vaginal and endocervical mucous membrane. (For a more detailed description of the technic of the operation and the indications for its use the reader is referred to Dr. Sturmdorf's article in Surg., Gyn., and Obst., 1916.)

The first step of the operation is to carry an incision completely around the cervix at the line of demarcation between the vaginal sheath and the diseased mucosa of the cervix. The vaginal sheath thus loosened is stripped back by blunt dissection as far as the level of the internal os. This important step should be carried out thoroughly even if it necessitates pushing back the

Fig. 271.—Sturmdorf's Operation.
Funnel-shaped cavity in cervical muscularis, after removal of cervical mucosa (after Sturmdorf).

bladder for some distance from the anterior cervical wall. If the vaginal cuff thus formed is not made ample there will be lack of healing, granulation and scar tissue formation resulting from overtension of the flaps.

The everting diseased cervical mucosa is next circumcised and carefully cored out with a sharp knife, somewhat in the manner of Hagar's amputation, excepting that it is very important to preserve the peripheral muscular layers of the cervical wall.

The final step of the operation is to line with the loose vaginal cuff the funnel-shaped cavity left by the removal of the cervical cone. The tissue of the cuff should be trimmed so that when sutured in place it will accurately fit the cavity without undue tension. The complicated stitch for coaptating the

vaginal cuff to the endocervical mucosa may be learned by referring to the accompanying drawings which are copied from Sturmdorf's original article.

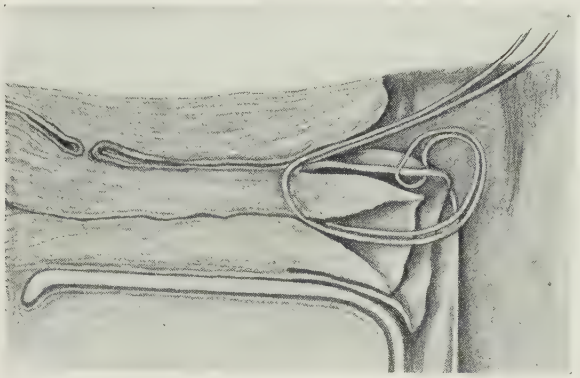

FIG. 272.—STURMDORF'S OPERATION.
Schematic sagittal view of anterior suture course.

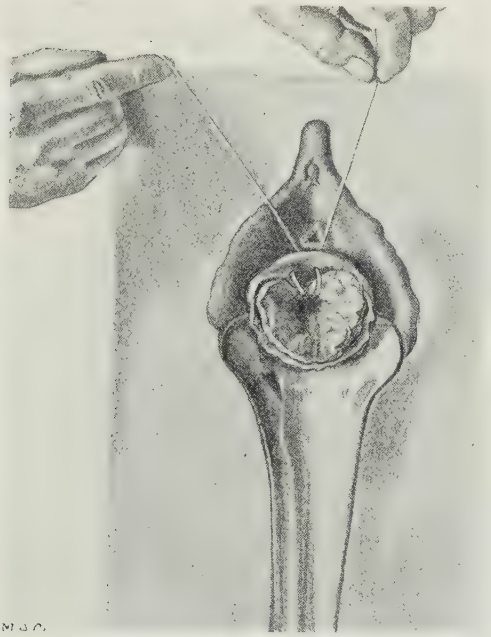

FIG. 273.—STURMDORF'S OPERATION.
The anterior stitch placed.

Sturmdorf uses silkworm-gut for the two main sutures, leaving the ends long to facilitate removal. He recommends a double curved Peaseley needle for passing the suture through the cervical lips, as seen in the picture.

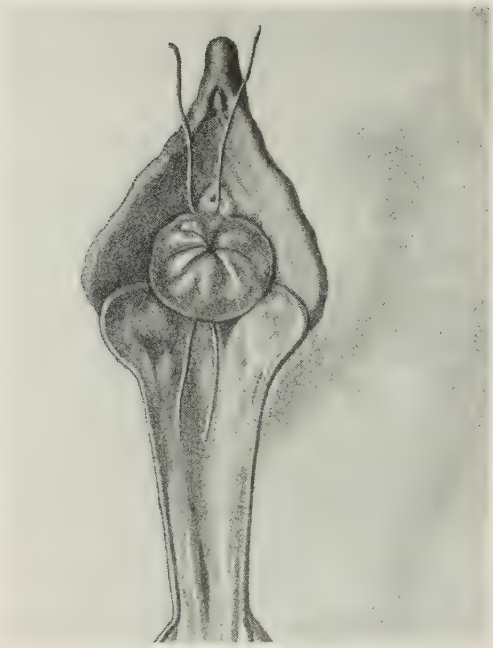

Fig. 274.—Sturmdorf's Operation.
The operation finished.

## CAUTERIZATION FOR ENDOCERVICITIS

A simple and often effective method of treating chronic endocervicitis is by the use of the electric cautery. The cervix is first dilated, the lips being held

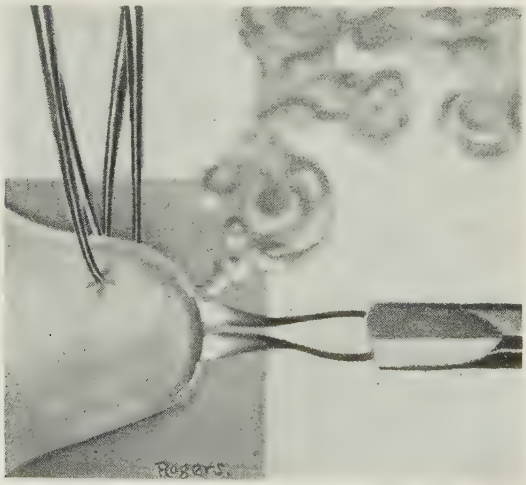


Fig. 275.—Cauterization for Endocervicitis.

as widely apart as possible by double hooks, anterior and posterior. Deep incisions are then made into the endocervical tissue parallel to the canal and

radiating from the center. The incisions should be carried as high as the

FIG. 276.—CAUTERIZATION FOR ENDOCERVICITIS.

internal os. If there is eversion or erosion the incisions may be carried out to the healthy membrane.

### ANTERIOR COLPOPLASTY. (AUTHOR'S METHOD.)

The description of this operation can be understood only by reference to the accompanying cuts and diagrams.

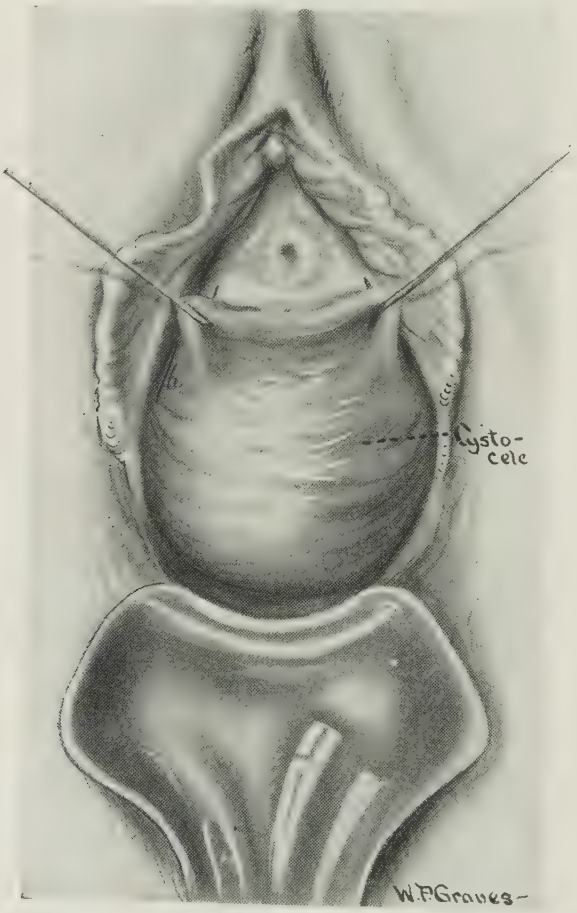


Fig. 277.—Operation for Cystocele. (Author's method.)

In order to expose the cystocele before beginning the denudation, tenacula are placed in the upper angles of the introitus and drawn upward and outward. This brings the cystocele into a convenient position for operation.

The field of operation is exposed by inserting tenacula in the upper angles of the introitus made by the anterior fold of the vestibule with the lateral walls of the vagina (Fig. 277). By drawing the tenacula outward the whole cysto-

cele is brought into full view. The first step is to map out the area for denudation by selecting and marking the angles of the figure. The points *F* and *D* (Fig. 278) are first chosen by picking up the mucous membrane with two pairs of thumb forceps and drawing them together in the middle line. The points should be selected so that when approximated in front of the cervix the cystocele is entirely reduced and the tension is sufficient to form a sort of bridge in front of the cervix, forcing it backward. By pinching the forceps together the

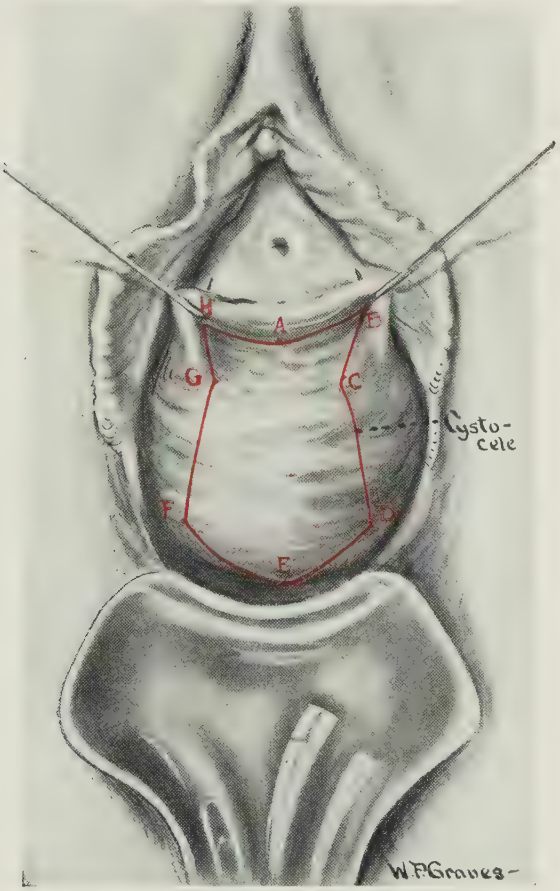


Fig. 278.—Anterior Colpoplasty.

points are marked in the mucous membrane. The points *G* and *C* are next selected. These are also chosen so that when approximated in the middle line the anterior part of the cystocele will be approximated. These points, *G* and *C*, are always closer together than *F* and *D*, because the vagina should not be drawn too tightly near the introitus. The point *E* is in the central line, just at the reflection of the vaginal mucous membrane from the portio of the cervix. When the points have been carefully marked, the area included between *E*, *D*, *C*, *G*, and *F* is denuded with Emmet's scissors. Experience has shown

that this method of denudation is safer, more rapid, and more satisfactory than removal of the mucous membrane by the splitting of a flap. When the area has been denuded a suture is first placed, entering the mucous membrane at *D*,

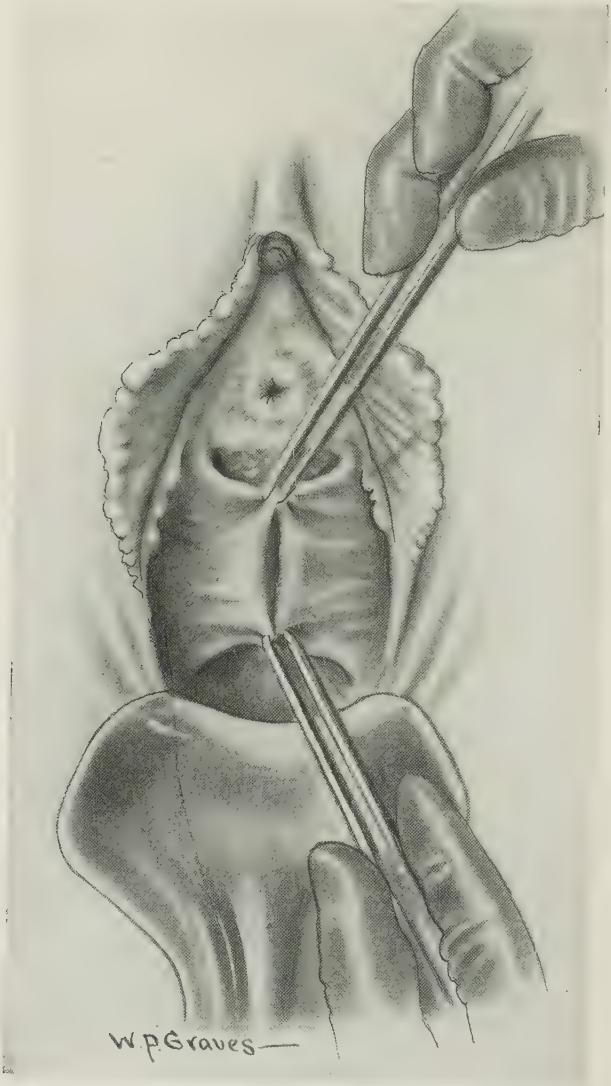


FIG. 279.—OPERATION FOR CYSTOCELE. ANTERIOR COLPOPLASTY. (Author's method.)
The amount of cystocele is determined by folding the redundant wall in the manner here depicted. By pressing the thumb forceps four landmarks are made in the mucous membrane which serve as a guide to the denudation. These four marks correspond to the points *A*, *B*, *C*, and *D* in the diagram (Fig. 278).

passing across the cystocele, and issuing at *F*. The ends of the suture are clamped and drawn sharply upward by the assistant. This approximates and brings into easy reach the edges *E*–*F* and *E*–*D*, which are then united by several interrupted sutures.

The first stage of the operation is now completed, and should result in reducing the posterior part of the cystocele and drawing a tight bar of tissue across the front of the cervix. The second stage of the operation is directed to the anterior part of the cystocele which includes the urethra. This portion is usually protuberant, though the prominence of the tissue is often due rather to hypertrophy of the vaginal wall than to hernia of the urethra.

A point *A* is selected several centimeters from the urethra, which will, without too great tension, meet the points *G* and *C* when brought together in

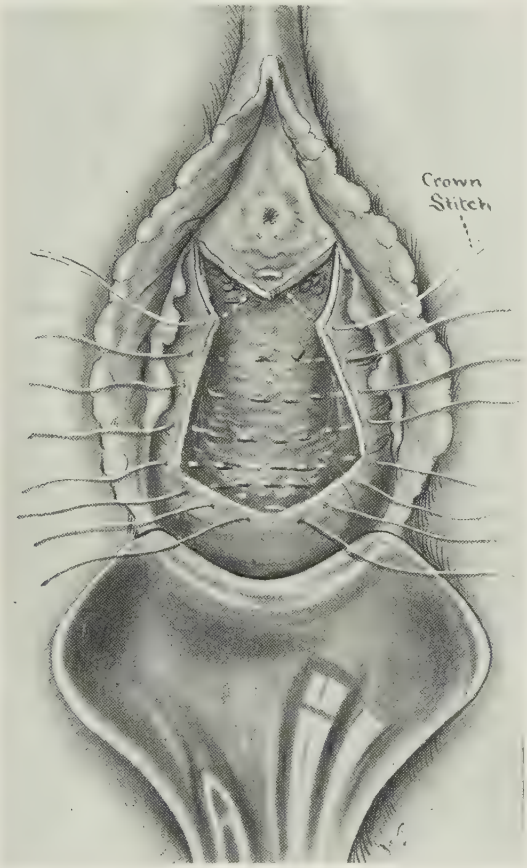


FIG. 280.—OPERATION FOR CYSTOCELE. (Author's method.)
Stitches placed and ready for tying.

the middle line. The points *H* and *B* are determined by the insertion of the tenacula. The area included between *G*, *H*, *A*, *B*, and *C* is then denuded. A crown suture entering near the angle *C*, including the angle *A* in the manner of a mattress suture and issuing at *G*, is then passed and the ends clamped. By drawing this suture sharply to the left the edges *H*–*G* and *H*–*A* are approximated and sewed with interrupted sutures, and by drawing the suture sharply to the right the edges *A*–*B* and *B*–*C* are united in a like manner. The

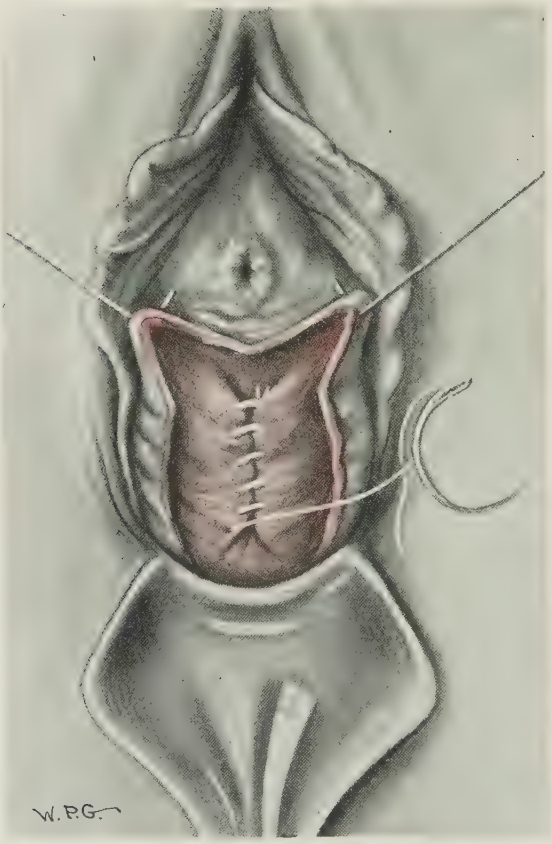


Fig. 281.—Operation for Cystocele (Author's Method).

Buried running stitch, implicating the bladder wall, to be used in cases of marked cystocele. The stitch should be passed so as to include the fascial investment which lies between the bladder and vaginal walls.

crown suture is then tied, two or three stitches placed between *G* and *F*, and the operation is completed.

By carrying out this technic the cystocele is reduced throughout and the wound edges are all accurately approximated.

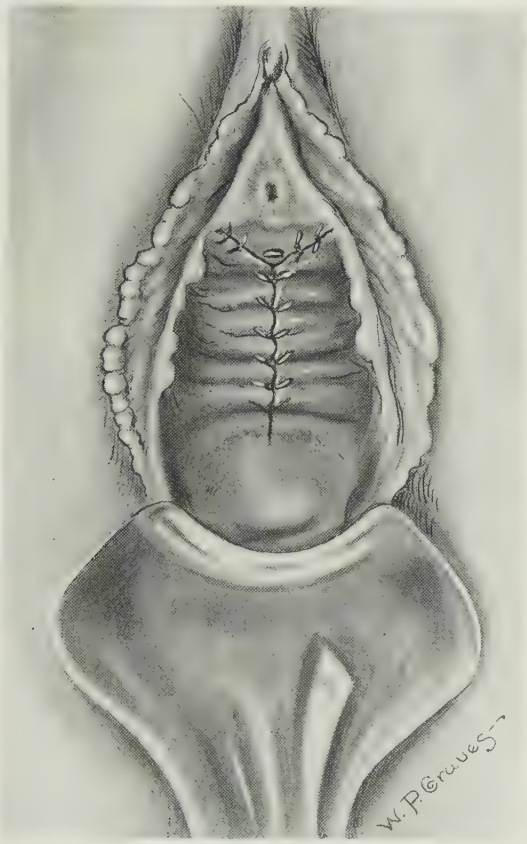


Fig. 282.—Operation for Cystocele. (Author's method.)
Sutures tied, operation completed. The anterior vaginal wall should at the finish of the operation have a concave contour.

If the cystocele is very marked it is a good plan to enfold the bladder by a row of buried No. 00 catgut sutures before placing the main sutures.

It should be remembered that this operation, like all plastic operations on the anterior wall, cannot be depended on of itself to maintain a permanent reduction of the cystocele if there is present at the same time a prolapse of the uterus. As prolapse and cystocele usually go hand in hand, the operation for cystocele is valuable chiefly when used in combination with an appropriate suspensory operation for relief of the prolapse.

## OPERATION FOR FUNCTIONAL INCONTINENCE OF URINE

Numerous operations have been devised in times past for functional incontinence. One type of operation is based on the principle of narrowing the external orifice, another of reduplicating and folding in the urethra along its entire

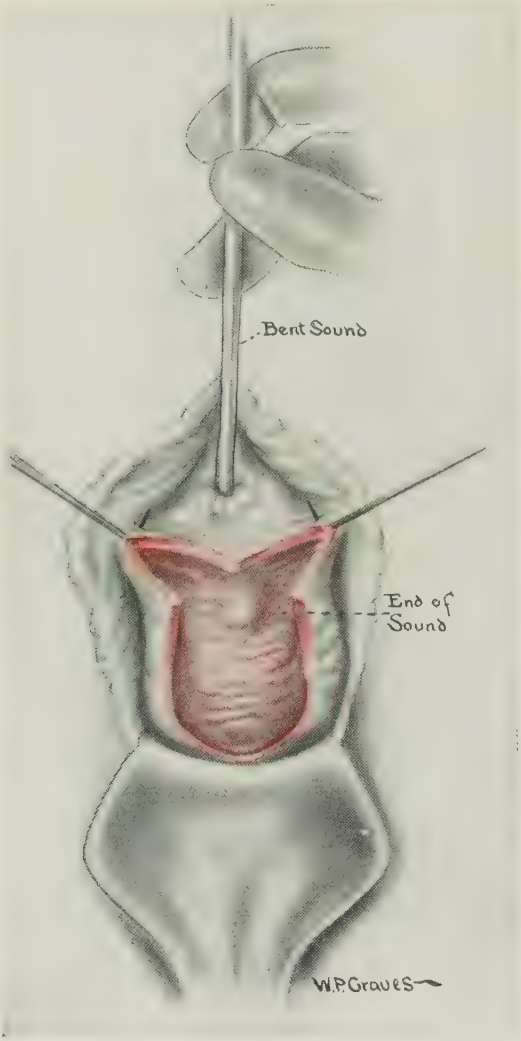


FIG. 283.—KELLY'S OPERATION FOR FUNCTIONAL INCONTINENCE OF URINE, COMBINED WITH THE AUTHOR'S ANTERIOR COLPOPLASTY.

The anterior vaginal wall has been denuded as for a cystocele, except that the corners of the flaps have been dissected up in the region of the neck of the bladder and of the urethra. The drawing shows the method of determining the position of the neck of the bladder. A uterine sound is slightly bent at the end and introduced into the bladder. The neck of the bladder can easily be perceived as the end of the sound passes it.

course (Pawlik, Duret). Gersuny advocated dissecting out the urethra and twisting it so as to narrow the canal. In still another form of operation the urethra is transplanted so that the meatus is brought near the clitoris (Albarran,

Dudley). In this way the urethra is made to describe a sharp bend around the symphysis. The author has tried all of these methods, and finds that, though temporarily successful, they usually result in recurrence after a few months. The operation devised by Kelly, however, produces a high percentage of permanent cures. This operation depends for its success on suturing together the lacerated or relaxed tissues of the sphincter at the neck of the bladder.

Inasmuch as a considerable proportion of women with functional incontinence also have a cystocele, we have successfully combined Kelly's operation with the

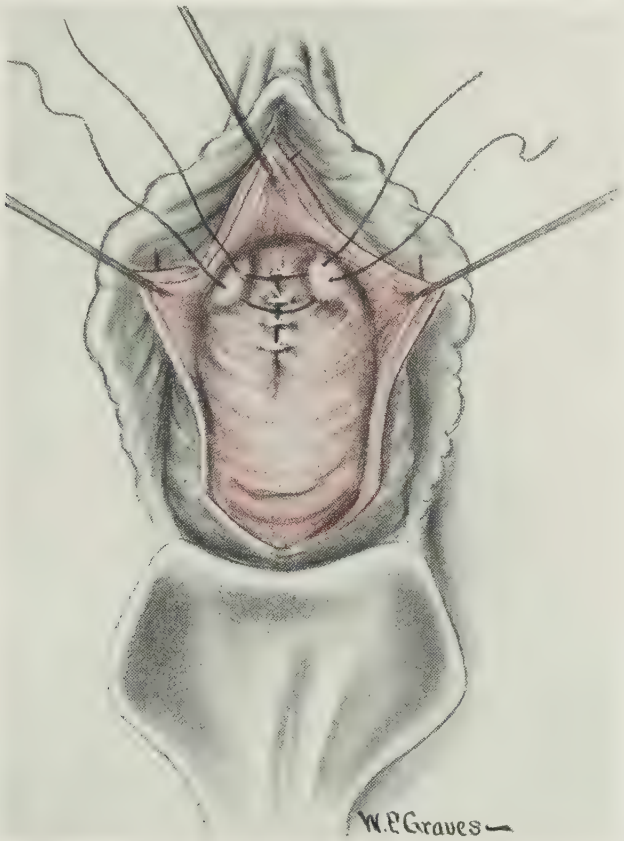


FIG. 284.—OPERATION FOR FUNCTIONAL INCONTINENCE OF URINE. KELLY'S METHOD COMBINED WITH THE AUTHOR'S OPERATION OF ANTERIOR COLPOPLASTY.

Sutures have been placed and tied, narrowing the internal orifice of the urethra. Two linen sutures are shown placed in the unyielding tissue at the sides of the urethra. When these sutures are tied a firm supporting bridge is created, guarding the first line of sutures.

author's anterior colpoplasty. The operation is as follows: The anterior vaginal wall is denuded in exactly the same way as in the operation for cystocele described on page 651. When the denudation has been completed, the urethra is then dissected out with blunt curved dissecting scissors. This leaves the flaps at the upper part of the operative field free. Tenacula are then inserted in the three converging angles and the flaps drawn sharply outward. In this way the

urethra at its entrance into the bladder and the surrounding tissue are widely exposed to view (Fig. 284). A uterine sound, with its point slightly bent, is now introduced into the bladder. As the point of the sound passes the internal orifice of the urethra it gives a slight but very perceptible jump. This point is readily marked by feeling the end of the sound from the side of the vaginal wound. By pressing backward on the handle of the sound the exact location of the bladder neck can be kept constantly in view. Several interrupted sutures

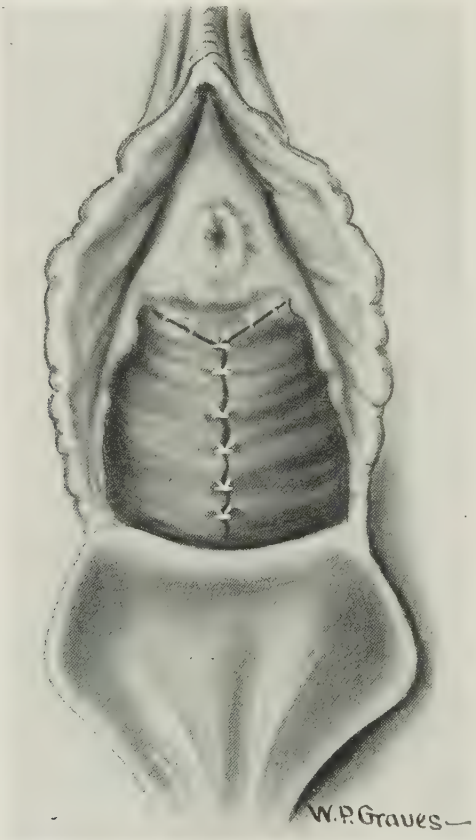


Fig. 285.—Kelly's Operation for Incontinence Combined with the Author's Anterior Colpoplasty. Operation Completed.

of fine linen are then passed, picking up ragged tissues on each side of the urethra at the level of its entrance into the bladder. These sutures are tied in the middle line, and serve to compress the internal orifice, as can be plainly tested by drawing out and again inserting the bent sound. The sutures thus placed are reinforced by two or three other sutures of linen, which pick up firm unyielding fibrous tissue well up on the sides of the urethra.

The operation for cystocele is then continued in the usual manner, provision being made to give a little extra tightness at the point corresponding to the neck of the bladder. When finished the appearance is like that seen in Fig. 285.

## ANTERIOR COLPOPLASTY (CLARK'S TECHNIC)

In the operation of anterior colpoplasty just described the operative field is exposed by simple denudation of the vaginal mucous membrane. Another type of operation for cystocele consists in separating completely the vaginal membrane from the bladder wall. Of these two methods we prefer the former, as it is more rapid and involves less danger from bleeding or injury to the bladder

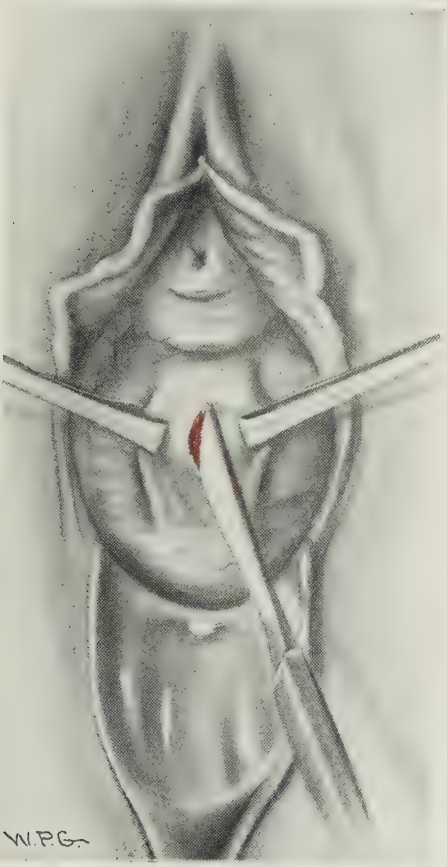


FIG. 286.—ANTERIOR COLPOPLASTY.
Initial incision of vaginal mucous membrane.

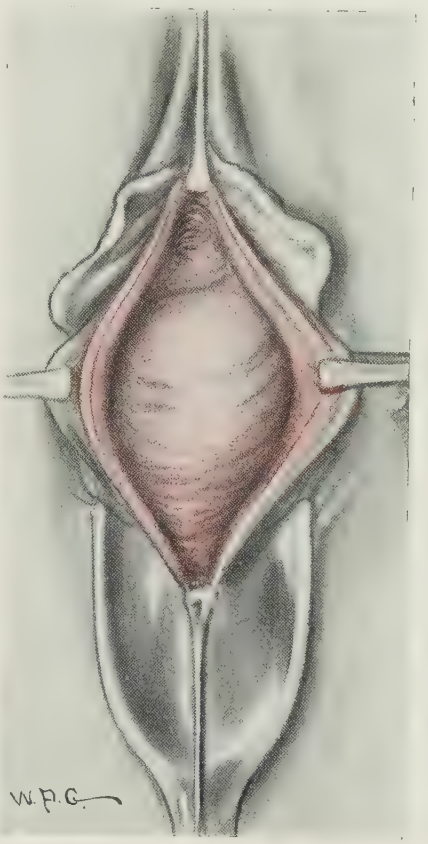


FIG. 287.—ANTERIOR COLPOPLASTY.
The mucous membrane of the vagina has been incised and the vaginal and bladder walls freely separated by blunt dissection.

wall, while the ultimate results are equally as good as those from the second more radical method. Many surgeons, however, prefer the flap-splitting procedure.

The anterior vaginal wall is first seized with tenacula at the most prominent part of the cystocele. The tenacula are drawn sharply out, leaving a ridge of tissue which is incised for a short distance between the tenacula, as in Fig. 286. With the aid of the knife and with blunt dissection the incision is carried into the tissues until the plane of cleavage between bladder and vagina is reached. The

two surfaces are then separated by blunt dissection so as to allow the incision to be extended in both directions. Anteriorly the incision is carried well toward the meatus so as to include the prominence usually described as urethrocele. Posteriorly the incision is carried to the junction of cervix and bladder. The ends of the incision are seized with tenacula. The next step is to separate as completely as possible the anterior vaginal wall from the bladder. This is done mostly

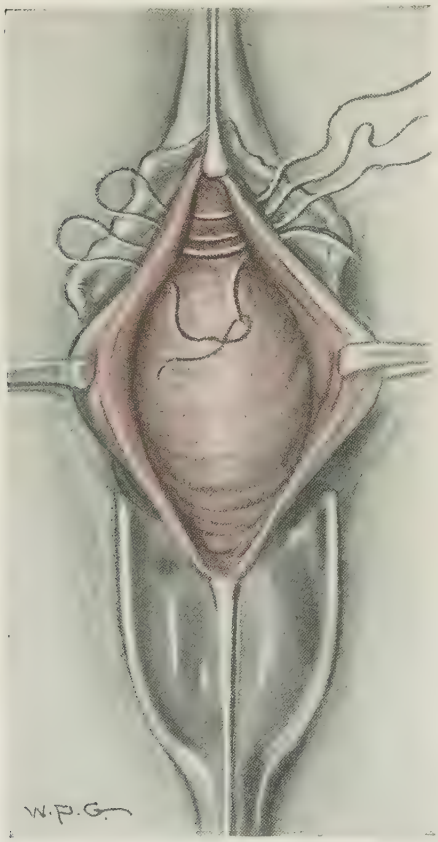

FIG. 288.—ANTERIOR COLPOPLASTY (CLARK'S TECHNIC).

Two or three mattress sutures are placed well out on the sides and in relation to the neck of the bladder. In the drawing they are represented somewhat nearer the meatus than they should be. These sutures are placed for the purpose of relieving functional incontinence.

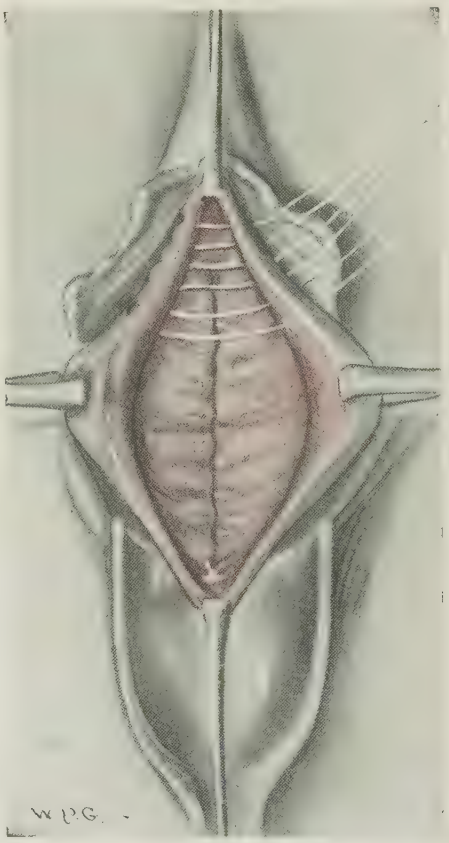

FIG. 289.—ANTERIOR COLPOPLASTY (CLARK'S TECHNIC).

The mattress sutures have been placed. The hernial protrusion of the bladder has been infolded by a buried Cushing stitch, which is passed so as to include the investing fascia which lies between the vaginal and bladder walls.

by blunt dissection with the finger, though occasional tissue fibers require cutting with scissors. Gauze should not be employed as it increases the danger of injuring the bladder. All bleeding points should be controlled at once and tied. The separation is carried out well down on the sides of the cystocele. The urethra in its upper third at the base of the bladder should be thoroughly exposed. In stripping the vagina from the bladder care should be taken to leave the thin

aponeurotic membrane which will be found investing the bladder. This will be seen to be slender and attenuated at the center of the cystocele, but strong and well marked on the sides. The next step is a technical maneuver introduced by J. G. Clark, which is designed to control the functional incontinence from which many patients with cystocele suffer to a greater or less extent. Two mattress sutures of No. 1 catgut are placed well up into the angles on the sides of the urethra

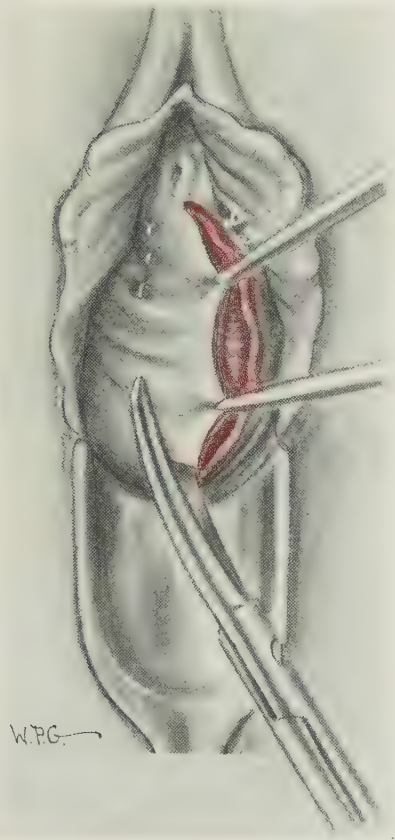


FIG. 290.—ANTERIOR COLPOPLASTY (CLARK'S TECHNIC).

The mattress sutures have been tied. The excess of vaginal mucous membrane is being trimmed away.

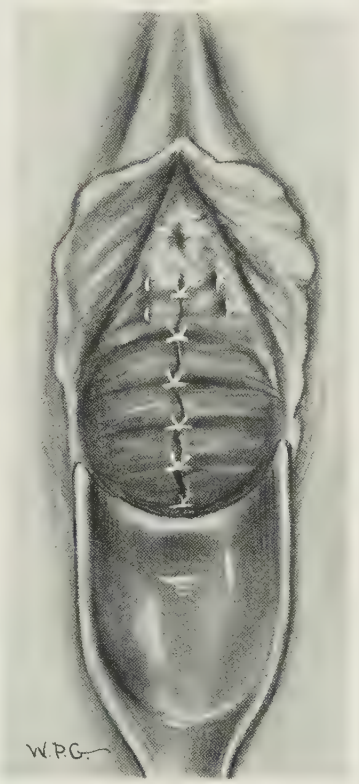


FIG. 291.—ANTERIOR COLPOPLASTY (CLARK'S TECHNIC).

The vaginal wound is closed with interrupted catgut sutures.

and crossing the urethra near its junction with the bladder (Fig. 288). The ends of the sutures are clamped and not tied until all the external sutures are placed.

The next step in the operation is to implicate the hernial protrusion of the bladder by a continuous No. 1 catgut suture. Clark's method of employing the Cushing stitch is an excellent one. In applying the implicating stitch it should be carried well out on the sides of the protruding bladder and include the aponeurotic investiture mentioned above, for it is on this fascial support that the final

success of the operation largely depends. When the implicating stitch has been applied it will be found that there usually exists a greater or less excess of vaginal membrane. This excess of membrane is then trimmed off. The amount of membrane to be removed requires good judgment. Care must be taken not to cut away too much, for if the edges of the wound are approximated under too great tension it may favor the later formation of obstructing and painful scars in the vagina.

The wound is closed with interrupted sutures of No. 1 chromic gut.

### OPERATION FOR CYSTOCELE (WARD'S METHOD)

The following operation is an excellent method for reduction of a cystocele, employing as it does the deep uteropubic fascia and the bases of the broad ligaments as a means of support. In cases complicated by prolapse of the uterus, some form of abdominal suspension should be added to the plastic operation on the cystocele.

An inverted ⊥-shaped incision is made on the anterior vaginal wall, and the bladder separated from the vagina. The dissection is carried out on the

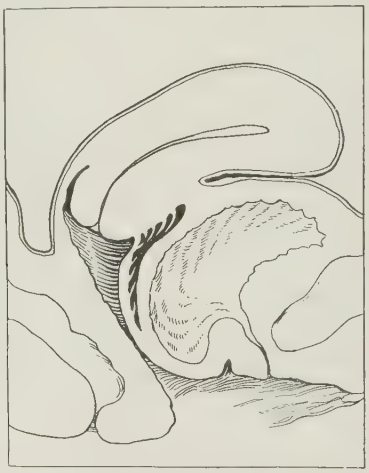

FIG. 292.—WARD'S OPERATION FOR CYSTOCELE.

Showing the "weak spot" at the junction of cervix and bladder, resulting from injury during parturition. This allows the bladder to descend and the anterior vaginal wall to be lengthened, under the influence of stretching (after Ward).

sides far enough to expose the so-called bladder pillars (see drawing). Anteriorly the dissection is continued only to the urethrovesical junction, and should be narrow at this point. Posteriorly the dissection reaches the peritoneal reflection between bladder and uterus, but does not enter the peritoneal cavity. The bladder wall is then seized in the midline and sutured to the anterior wall of the uterus at a point above the internal os, thus making a new and higher

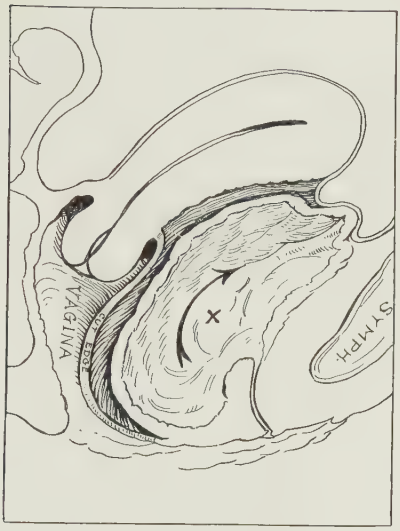


FIG. 293.—WARD'S OPERATION FOR CYSTOCELE.

Diagrammatic representation of the first step of the operation in which the vaginal wall is incised, and the bladder separated from the vagina and anterior wall of the uterus as far as the peritoneal reflection (after Ward).

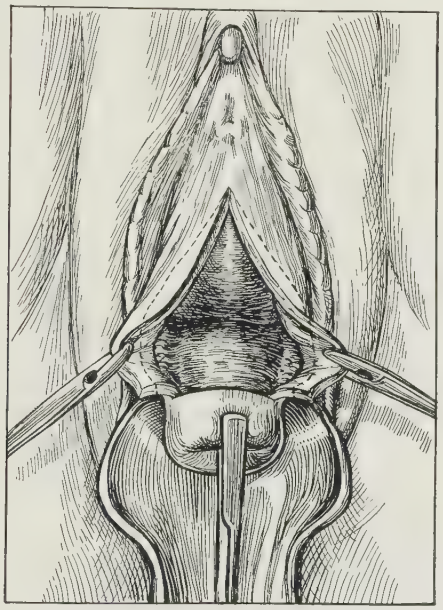

FIG. 294.—WARD'S OPERATION FOR CYSTOCELE.

T-shaped incision showing the separation of the bladder from the vagina and uterus and exposing the base of the broad ligaments. The bladder is not widely separated from the vagina at the urethrovesical junction in order that it may make traction on the bladder base. The dotted lines indicate the excess vaginal wall to be cut away (after Ward).

attachment of the bladder to the uterus. The edges of the vaginal flap are trimmed, wide at the cervical end and narrow at the urethrovesical junction,

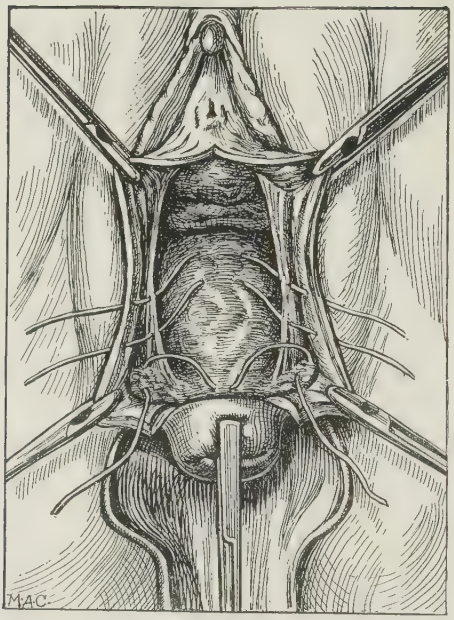

FIG. 295.—THE DISSECTION OF THE UTEROPUBIC LIGAMENTS (BLADDER PILLARS).

Showing their origin from the base of the broad ligaments. The sutures attaching the bladder high up on the anterior uterine wall have been tied and are not seen in the drawing. The mattress-suture uniting the bases of the broad ligaments has been placed (the lowest of the three sutures seen), and when tied serves to elevate the cervix and throw it backward (after Ward).

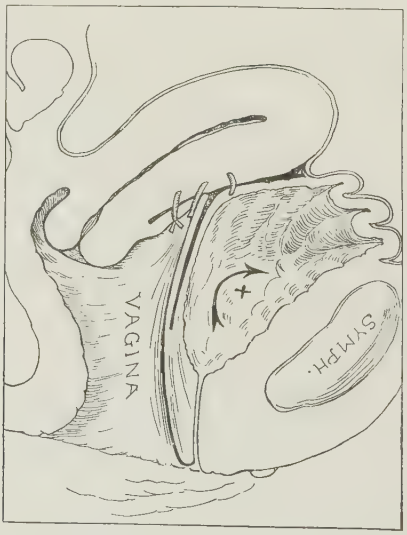


FIG. 296.—WARD'S OPERATION FOR CYSTOCELE.

Showing the second step of the operation by which the bladder is drawn upward and attached to the uterus in a new position, well above the internal os. This maneuver not only straightens out the lower portion of the bladder, but also by traction straightens and shortens the lengthened vaginal wall. The drawing also shows the two sutures that have been placed through the fascial bladder pillars and the uterine wall above the level of the internal os. The mattress-suture that approximates the bases of the broad ligaments is not shown (after Ward).

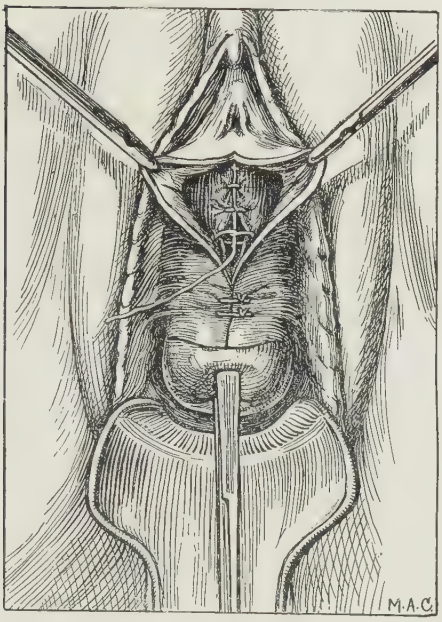


FIG. 297.—WARD'S OPERATION FOR CYSTOCELE.

The deep stitches shown in the preceding drawings have been tied. The uteropubic ligaments are being united by a running lock stitch. The edges of the vaginal wound have been trimmed so as to secure proper coaptation (after Ward).

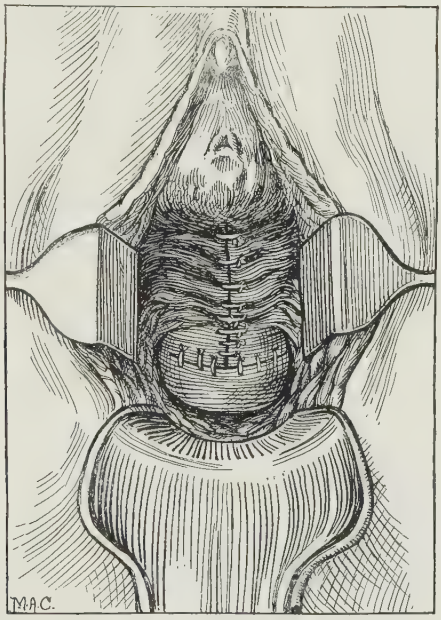


FIG. 298.—WARD'S OPERATION FOR CYSTOCELE. OPERATION FINISHED.

so as to remove the excessive vaginal tissue of the midline. Two sutures of catgut are then introduced through the bladder pillars and vaginal wall of each

side, and including the uterine wall at a point above the internal os and just below where the bladder has been sutured in its new attachment.

If there is an associated prolapse of the uterus the dissection is extended on each side of the cervix until the lower parts of the broad ligaments are developed. The lower portions of the two ligaments are then approximated in the midline by a mattress-suture. By this means the uterus is elevated and the cervix thrown permanently back. The bladder pillars are then united by a running catgut stitch, and the three sutures above described snugly tied. The operation is finished by approximating the edges of the vaginal wound.

### COMBINED AMPUTATION OF CERVIX AND ANTERIOR COLPOPLASTY

The following operation entails a more extensive anatomic dissection than does the Hegar's amputation combined with a simple anterior colpoplasty, and

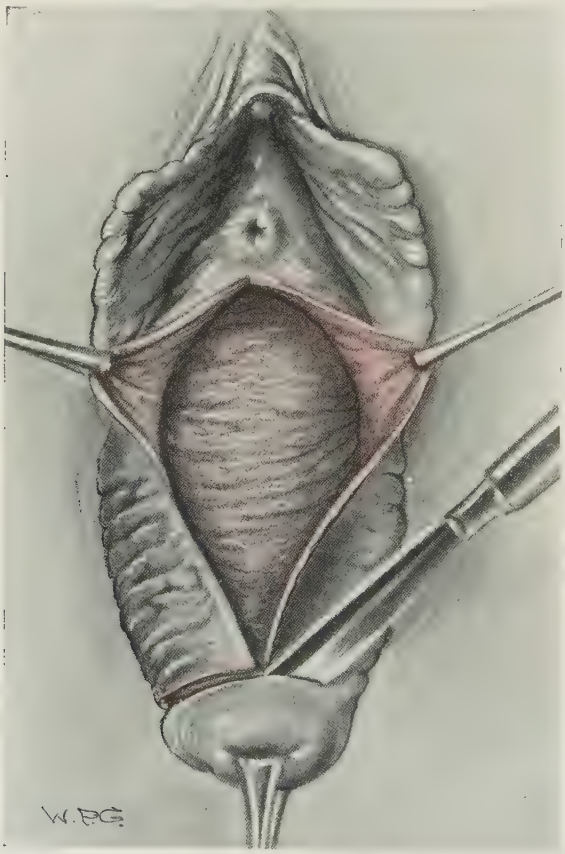

FIG. 299.—AMPUTATION OF CERVIX AND ANTERIOR COLPOPLASTY (STUDDIFORD).
The vaginal mucous membrane over the cystocele has been incised and the vagina and bladder walls freely separated by blunt dissection. The cervix is being circumcised.

should not be attempted by an inexperienced operator. The technic here described is in general that recommended by W. E. Studdiford.

The cervix is grasped with double hooks and drawn strongly outward and downward so as to expose the entire cystocele. A median incision is made through the vaginal mucous membrane from a point $\frac{1}{2}$ or $\frac{3}{4}$ inch below the meatus to the junction of the vagina with the portio vaginalis of the cervix. The plane of cleavage is found between the vaginal and bladder walls

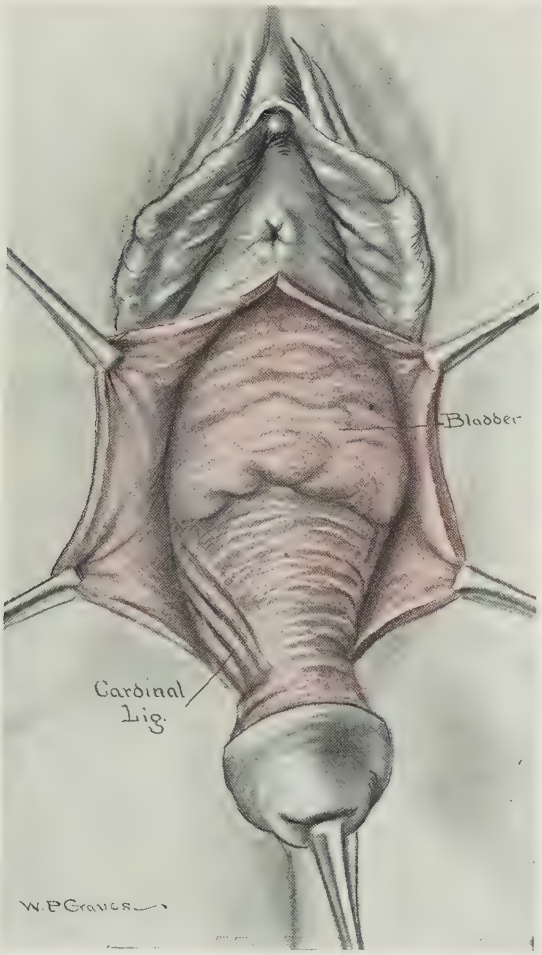


FIG. 300.—AMPUTATION OF CERVIX AND ANTERIOR COLPOPLASTY (STUDDIFORD).

The bladder has been exposed and stripped back from the cervix. In the case from which this drawing was made the cardinal ligaments were exposed on the right. On the left they had been torn away during the process that led to the condition of prolapse.

and the vagina stripped away widely on each side of the central incision. It is of importance to carry this splitting of the two walls far out on the sides of the cystocele, and it should be especially thorough at the level of the neck of the bladder. The cleavage of the two walls is accomplished by the gloved finger and with blunt dissection. Many use gauze to hasten the dissection, but this technic adds much to the danger of rupturing the bladder wall.

When the dissection of the surfaces has been completed the cervix is circumcised at the point of junction of the vagina and portio. The vaginal flaps are seized in tenacula and drawn outward and the dissection of the flaps continued behind the cervix. This gives a very free exposure to the bladder, which is now stripped back until the level of the internal os is reached. The extent of this part of the dissection depends on the length of the cervix, which in marked

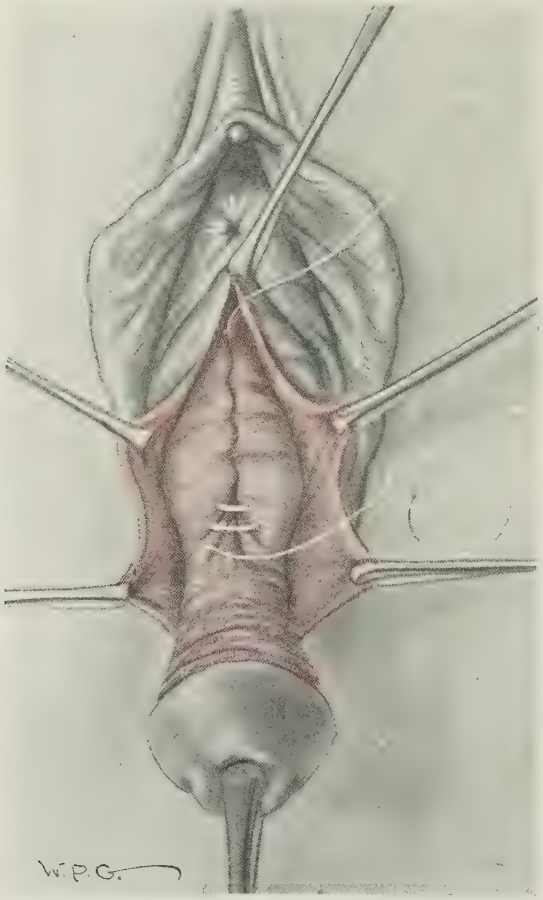


Fig. 301.—Amputation of Cervix and Anterior Colpoplasty (Studdiford).
The hernial protrusion of the bladder has been infolded by a Cushing stitch.

cases of procidentia is usually considerable. The cervix is still further freed laterally and posteriorly. As the elongated cervix is developed the fibers of the important cardinal ligaments are brought into view, unless they have been torn or stretched away during the process of the uterine prolapse.

When the cervix has been fully developed attention is directed to the bladder. A Cushing stitch is applied well out on the sides of the cystocele so as to infold the central part of the protruding cystocele. Care should be taken that the

suture includes at each bite a firm hold of the fascia which invests the bladder. In passing the stitch at the level of the neck of the bladder the needle is carried deeply into the firm tissue which lies at the sides of the urethra. This serves to rectify the functional incontinence with which many of these patients are troubled. It is a good plan at this stage to introduce the retention mattress stitch depicted on page 660. When the protruding cystocele has been implicated the amputation of the cervix follows as the next step.

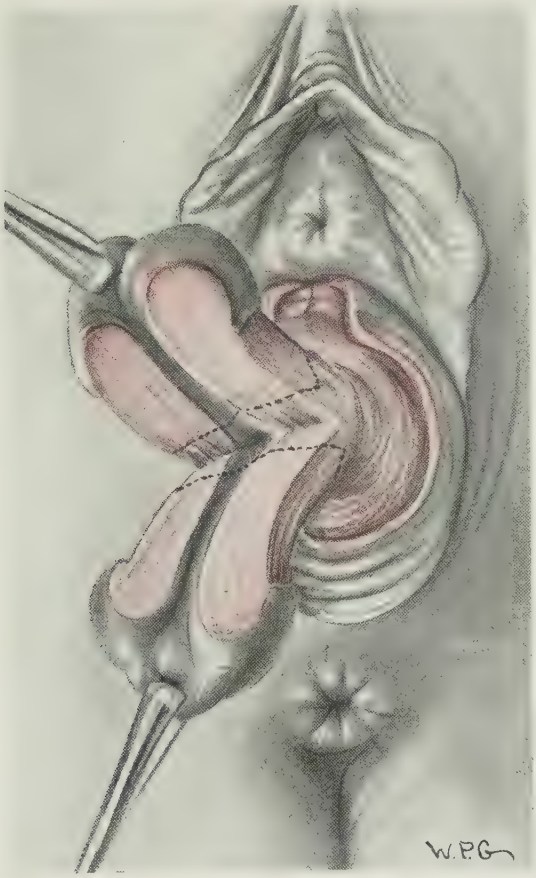


Fig. 302.—Amputation of the Cervix and Anterior Colpoplasty (Studdiford).
The cervix has been bisected and the two lips are to be amputated by wedge-shaped incisions.

The cervix is first bisected by a lateral incision up to the point selected for the amputation. The lips are drawn apart as in Fig. 302. Each lip is separately amputated by a wedge-shaped incision as depicted in the drawing, so as to leave two pouting projections on each lip (Fig. 302). The object of this is to secure an everting tube-shaped opening for the uterine canal.

Two catgut sutures are placed first through the posterior cervical lip-stump

and into the vaginal wall of corresponding points (Fig. 303) and tied. Two sutures are then placed through the anterior stump and including the angles of the vaginal flaps at each side of the original longitudinal incision. Sutures are placed at the angles of the cervical stump and into the edges of the mucous membrane on each side (Fig. 304). The final step is to complete the cystocele opera-

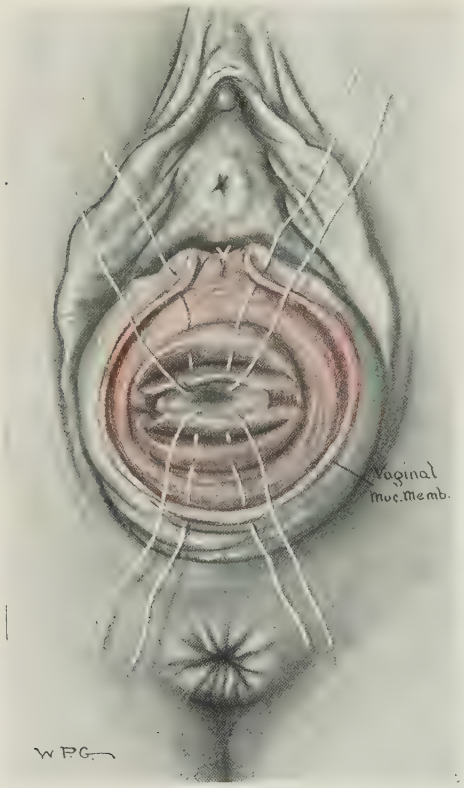


FIG. 303.—AMPUTATION OF CERVIX AND ANTERIOR COLPOPLASTY (STUDDIFORD).

The cervix has been amputated. The mucous membrane of the endocervix is being united to the vaginal mucous membrane. Note the manner in which the lips of the cervical stump are included in the sutures.

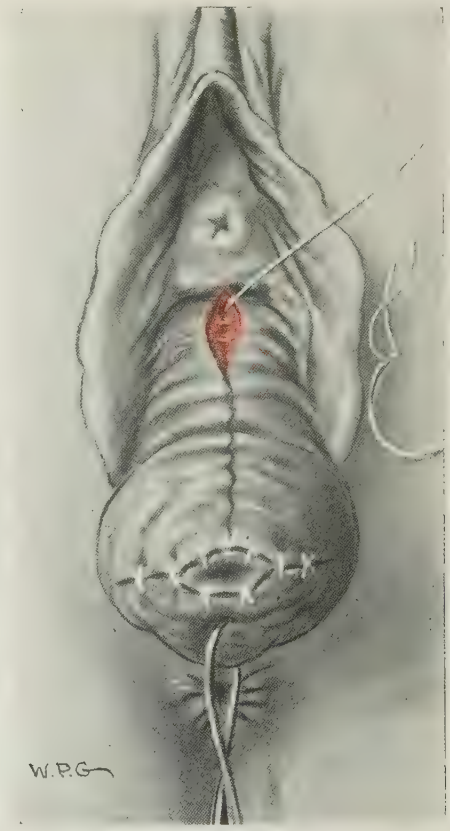


FIG. 304.—AMPUTATION OF CERVIX AND ANTERIOR COLPOPLASTY (STUDDIFORD).

The stitches in the cervical stump have been tied. The edges of the vaginal mucous membrane are being coaptated by a subcuticular stitch.

tion by uniting the two flaps of vaginal wall. In most cases the tissue is redundant and should be judiciously trimmed off. The edges may be united by a subcuticular running Cushing stitch or by interrupted sutures, preferably the latter.

## OPERATION FOR PROLAPSE OF URETHRAL MUCOUS MEMBRANE

Prolapse of the urethral mucous membrane may be complete or partial. Complete prolapse means that the membrane rolls outward throughout the entire circumference of the urethral canal, and presents at the meatus the appearance of a rosette. If the prolapsed tissue has become strangulated and gangrenous it should be removed after the manner of a Whitehead's operation for hemorrhoids. If the prolapsed membrane is healthy, a cure may sometimes be effected by tucking back the everted tissue, and then narrowing the lower third of the urethra by the operation described below in this section.

FIG. 305.—PROLAPSE OF URETHRAL MUCOUS MEMBRANE, SHOWING COMPLETE PROLAPSE WITH STRANGULATION.

FIG. 306.—PROLAPSE OF URETHRAL MUCOUS MEMBRANE SHOWING PARTIAL PROLAPSE OF THE LOWER WALL.

More commonly the prolapse is only partial, in which case the mucous membrane usually rolls outward from the lower half of the meatus. Operation for this condition consists in cutting out a wedge of tissue from the lower portion of the canal, including the redundant mucous membrane. The wound is closed by interrupted sutures of fine catgut. The same operation may be employed in cases of relaxed meatus, associated with functional incontinence. It may be used in conjunction with an operation for constricting the neck of the bladder in cases of incontinence.

As mentioned above, the operation on the meatus shown in the drawings is useful in cases of complete prolapse without strangulation when it is desired to narrow the lower urethra.

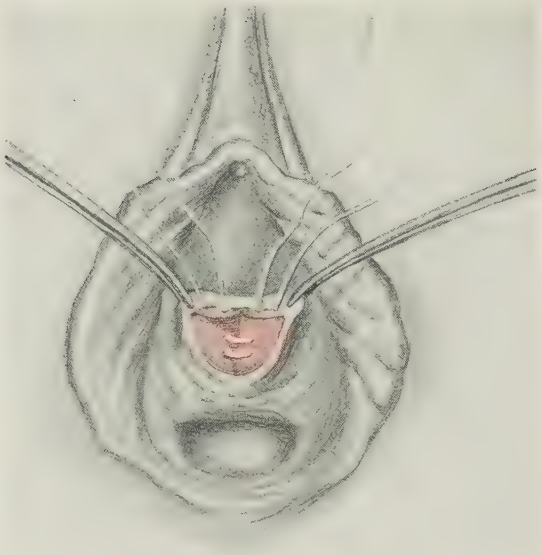

Fig. 307.—Prolapse of Urethral Mucous Membrane (Partial).

The redundant membrane has been removed by a wedge-shaped incision. Two stitches at the upper angle have been introduced. The stitches are continued in like manner so as to close the entire wound.

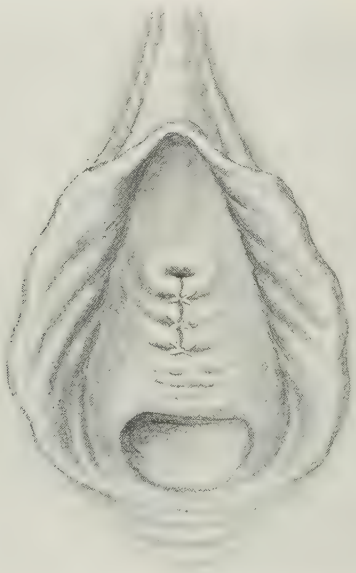

Fig. 308.—Prolapse of Urethral Mucous Membrane (Partial). Operation Finished.

### EMMET'S PERINEOPLASTY. (AUTHOR'S TECHNIC.)

**First Step.**—The posterior wall of the vagina is grasped with a pair of Cullen hooks at a point which when approximated to the anterior vaginal wall will touch it at the junction of the anterior and middle thirds of the urethra. If a cystocele has been performed by the method described on page 650 the point will correspond to the crown stitch on the anterior wall. A tenaculum is then placed just inside the opening of the left Bartholin's gland and drawn sharply outward,

FIG. 309.—OPERATION FOR LACERATION OF THE PERINEUM. (Emmet's method.)

Exposure of the lateral sulci and external perineum. Tenacula are placed at the orifices of the ducts to Bartholin's glands and drawn outward. A tenaculum or bullet forceps seizes a point on the posterior vaginal wall which when approximated to the anterior vaginal wall will touch it at the point of junction of the middle and outer thirds of the urethra. In denuding the lateral sulcus a tenaculum is placed at the natural angle formed by exposing the sulcus. (See Fig. 310).

while the traction forceps attached to the posterior wall is drawn in the opposite direction. This exposes a triangular depressed area or sulcus with the apex inside the vagina. The size of this area represents the amount of separation of the anterior fibers of the levator ani muscles (puborectalis) from the sides of the rectum. In the normal perineum, or one in which there has been no separation of the puborectalis, the triangular sulcus is either absent or insignificant.

A tenaculum is placed in the apex of the triangle. The instruments attached to the three angles are drawn strongly in divergent directions, so that the

triangle is mapped out by the tense folds of mucous membrane between them. Denudation of the triangle is best performed with Emmet's scissors, which first cut smoothly along the tense lines of mucous membrane and then remove the intervening tissue. The denudation can be done very rapidly by this method. The tenaculum forceps on the posterior wall are then drawn in the opposite direction and a tenaculum placed at the opening of the right Bartholin's gland. The instruments are drawn apart and the triangular sulcus of the right side exposed. The two triangles are rarely alike, as the separation of the puborectalis muscle is nearly always greater on one side than on the other. When this area is denuded

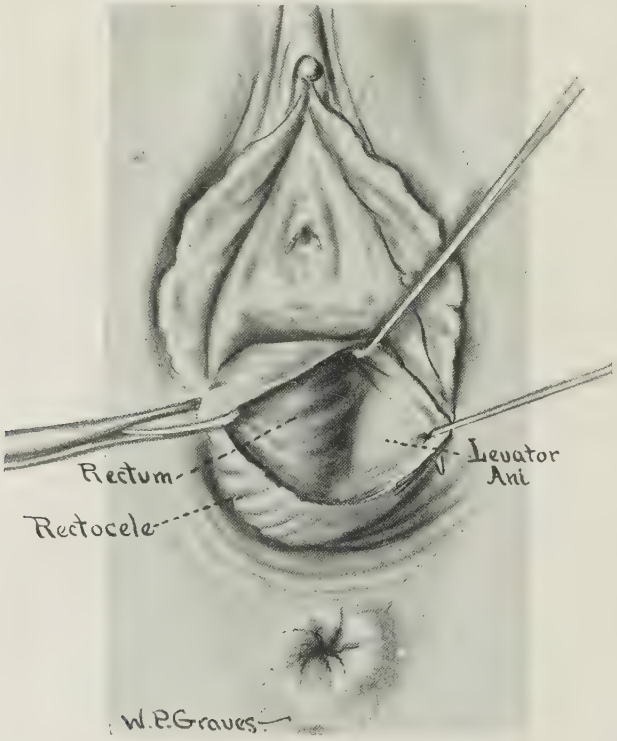


Fig. 310.—Operation for Laceration of the Perineum. (Emmet's method.)
The left lateral sulcus has been exposed and denuded.

in the same manner as that of the other side, the traction forceps is drawn upward toward the pubes in the middle line, while the tenacula in Bartholin's ducts continue to exert traction outward in opposite directions (Fig. 311). By this maneuver a third triangle is exposed corresponding to the so-called external perineum. This area is denuded, the first strip of membrane being removed by cutting smoothly from one tenaculum to the other. All important bleeding points of the exposed surface should be tied with fine catgut.

Beginning now on the patient's left the inside stitches are placed with the purpose of closing up the sulcus caused by the rupture of the puborectalis muscles, and restoring the former lateral vaginal support of the rectum. The

proper placing of these sutures is of supreme importance when there is any considerable amount of rectocele present. The triangular denuded area is now exposed by traction on the forceps and tenaculum. A catgut suture is then introduced, beginning at the outer side of the apex of the triangle. It is carried directly toward the operator, dipping well into the levator ani muscle, and is brought out in the external perineum. It is then reintroduced in the side

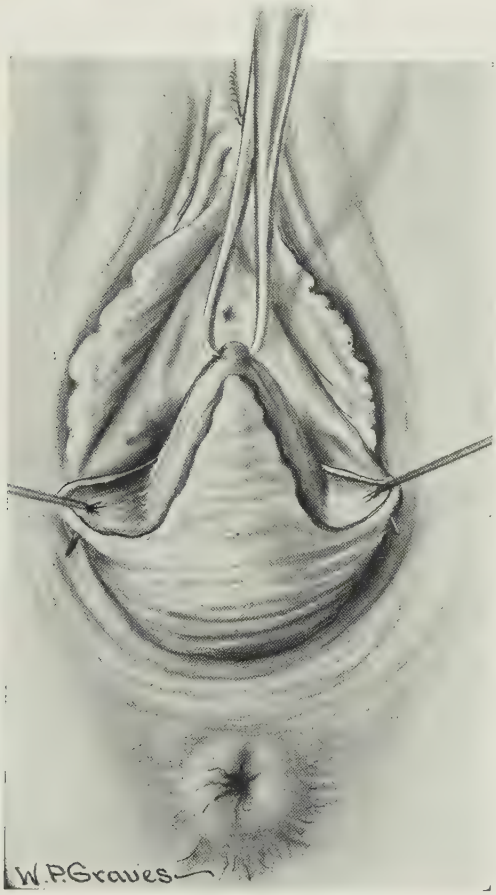


FIG. 311.—OPERATION FOR LACERATED PERINEUM. (Emmet's method.)

The two lateral triangles have been denuded and the third triangle of the external perineum is being exposed for denudation. The first cut with the scissors is in an even curving direction from tenaculum to tenaculum—the intervening tissue is then removed.

of the rectal portion, quilted superficially in the tissue, and carried directly backward toward the apex, where it emerges in the mucous membrane opposite the point from which it started. It is thus seen that the suture takes a V-shaped course, with the apex of the V in the external perineum, one leg of the V in the levator ani muscle, and the other in the side of the rectum (Fig. 312). It therefore reproduces quite faithfully, when tied, the attachment of the pubo-rectalis muscle. Two or three more stitches are then introduced in like manner.

If there is a rectocele present, the suture, which is quilted into the rectal portion, is curved around more and more toward the front, so that the last suture reaches the middle line (Fig. 313). The suture ends are clamped and the triangular sulcus of the other side is treated in the same manner. When all the sutures have been tied it will be found that the rectocele has entirely disappeared. By employing this method it is possible completely to reduce a rectocele of any size, with only a rare recurrence, and it is this part of the Emmet operation

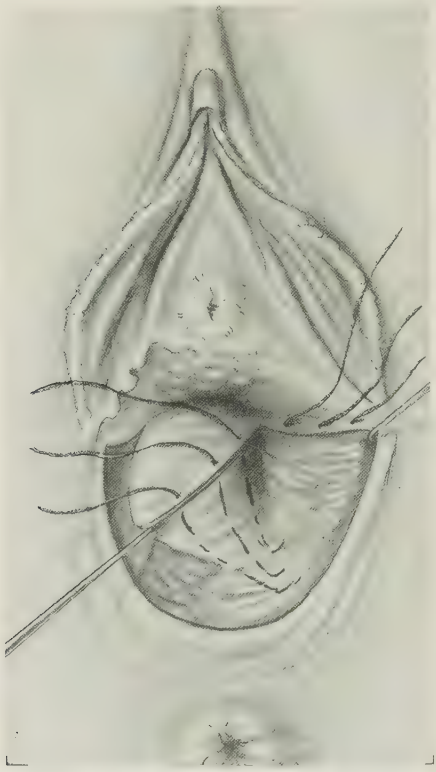

FIG. 312.—OPERATION FOR LACERATION OF THE PERINEUM. (Emmet's method.)
The denudation is complete. Sutures have been introduced in the left lateral sulcus. They are brought outward toward the external perineum, and then inward, making a V shape with the apex in the external perineal region.

which makes it superior to others for the treatment of rectocele and extensive relaxation of the perineum.

**Second Step.**—Having disposed of the rectocele, and restored the lateral vaginal attachments of the rectum, attention is now directed to bringing together the separated levator ani and transversus perinei muscles. In order to expose the field of operation and to indicate the final position of the perineal body, the last two internal sutures are not cut, but clamped together, and drawn strongly upward by the assistant until the posterior wall of the introitus touches the anterior, and held in this position until the end of the operation (Fig. 315).

The tissue of the external perineum is now dissected so as to give access to the separated levator ani muscles. This is quite important, especially when there is a considerable amount of scar-tissue present. No attempt is made to develop the muscular fibers of the levator muscles, for in this way fascial tissue is removed which is valuable for the purpose of union in healing. The fascial covering of the muscles should, however, be cleared of intervening scar and

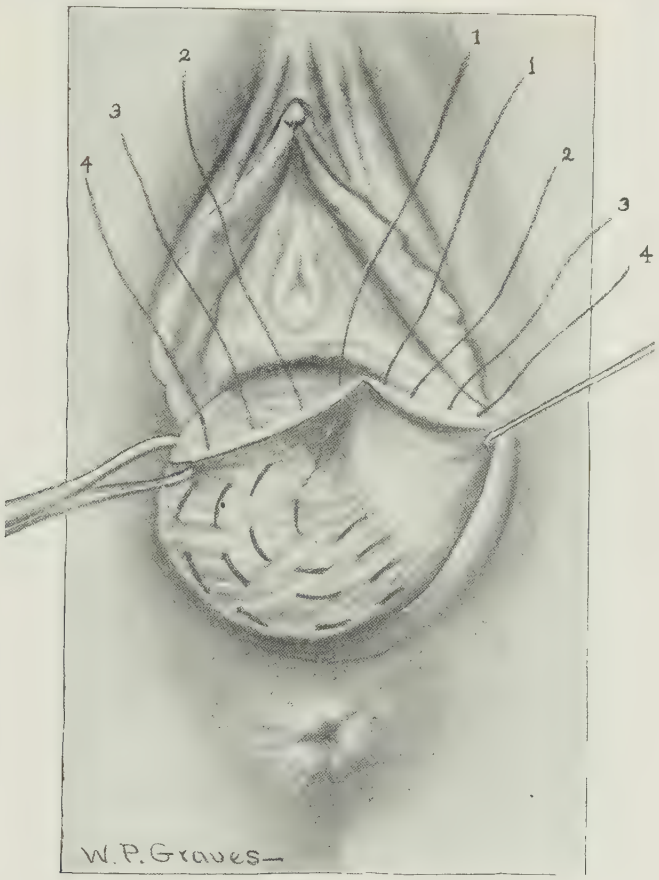


FIG. 313.—OPERATION FOR RECTOCELE.

The denudation is carried out as in the usual Emmet's perineoplasty. The reduction of the rectocele is accomplished entirely during the suturing of the lateral sulci. The stitches are carried deeply into the levator muscles on the sides. They are quilted into the rectal portion in the manner here shown, each one being carried further around toward the front until the last (fourth) stitch reaches the median line of the rectocele. When the stitches on both sides are drawn taut the rectocele is made to disappear.

fatty tissue. In order to facilitate the isolation and clearing of the muscles long-pointed tenacula are carried deep into the lower portion of the levators to the sides of the sphincter ani, and the muscle bellies brought prominently into view in the manner depicted in Figs. 315, 316. After removing all intervening tissue that may interfere with the union of the muscles, a figure-of-8 catgut stitch is introduced so as to create a broad surface of approximation of the two muscle

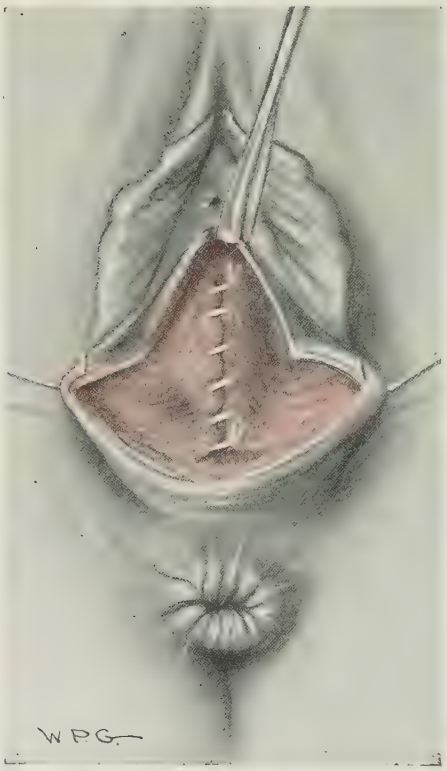


FIG. 314.—OPERATION FOR RECTOCELE.

Running buried catgut stitch implicating the rectal wall. This stitch is useful when there is marked hernial protrusion of the rectum. When the stitch has been placed the lateral sulci are closed in the usual way.

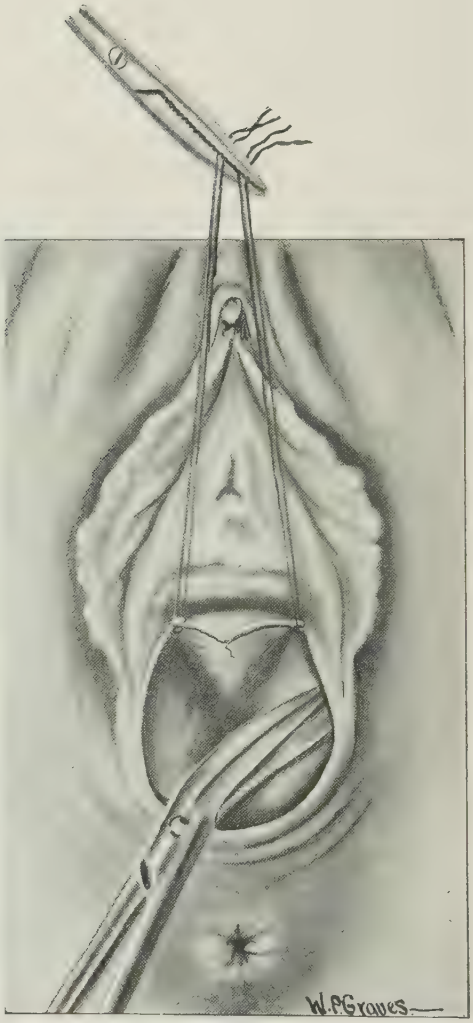


FIG. 315.—OPERATION FOR LACERATED PERINEUM.

The stitches of the internal part have been tied and cut with the exception of the last two sutures, the ends of which are left long to serve as tractors. The wound edge of the external perineum is trimmed so that the denuded figure is exactly symmetric. The drawing shows the levator muscles being freed, so that they can be easily approximated without tension.

bellies (Fig. 316). This suture is ultimately to be buried. It is drawn taut and clamped. The sutures of the external perineum are next applied, beginning at the top. The first stitch is merely for superficial approximation. It passes

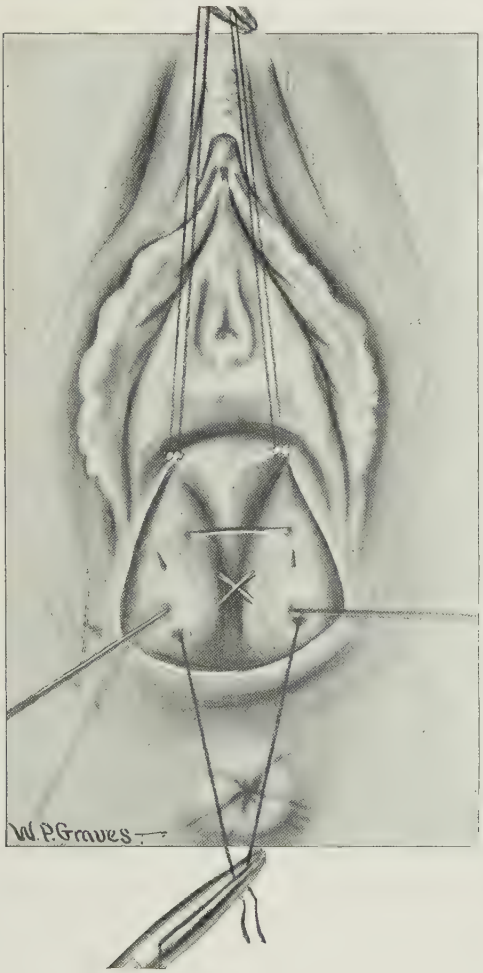


FIG. 316.—OPERATION FOR LACERATED PERINEUM.

The internal part of the operation has been finished and the last two stitches left long, so that they may be used as retractors. The skin has been freed up from the levator muscles. A buried figure-of-8 approximation stitch of chromicized catgut No. 0 has been introduced. The ends are not tied until the external stitches have been placed.

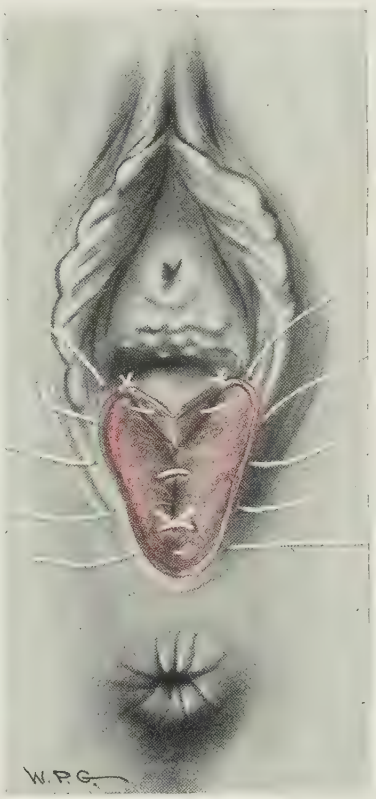


FIG. 317.—OPERATION FOR LACERATED PERINUEM.

The deep figure-of-8 catgut stitch has been tied and cut, thus approximating the levator ani muscles. Deep silkworm-gut sutures have been placed and are ready to be tied and shotted.

from side to side, including the small tongue of vaginal mucous membrane between the two last internal sutures. This tongue should first be trimmed so that when the suture is tied there will be perfect coaptation of the wound edges. Other sutures are now introduced, each one dipping deeply into

the bellies of the levator ani muscle, thus reinforcing the buried figure-of-8 stitch. The upward tension on the two internal stitches that are being held by the assistant should not be released until every suture is tied. The tying of the external sutures is, therefore, best begun at the anal end of the external

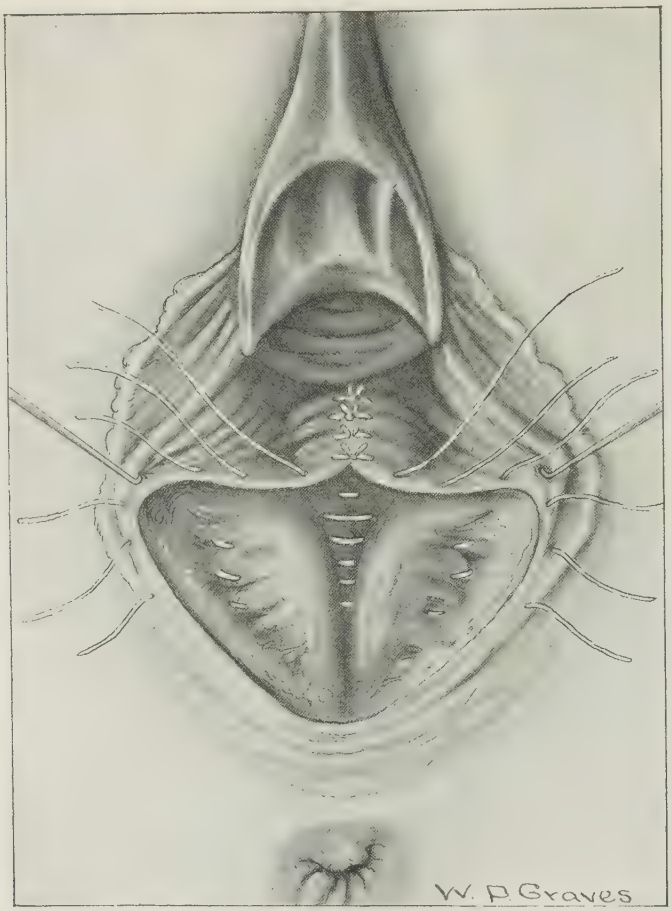


Fig. 318.—Operation for Lacerated Perineum.

In this operation a central denudation has been made and the sutures introduced from side to side, including the levator ani muscles from the point where they can be approximated. The inside sutures are of catgut and outside sutures of silkworm-gut. This operation is not as serviceable as the Emmet operation when there is much relaxation of the outlet. (Adapted from Holden's operation.)

wound. When all the stitches have been tied, the posterior surface of the introitus should impinge on the anterior.

Most operators at the present day use catgut for the external perineal stitches instead of silkworm-gut. Extensive experience with both sutures has convinced us that silkworm-gut sutures, individually shotted, conduce in the long run to cleaner wounds, shorter convalescences, and better end-results. The necessity of removing them on the ninth day is a disadvantage which is more than counterbalanced by the superiority of the local results.

## CLARK'S PERINEOPLASTY[1]

As has been previously stated, the distinctive principle of the Emmet operation consists in reducing the rectocele by drawing up the rectum on each side in the direction of the attachments of the levator ani muscles to the pubic rami. In another type of operation the rectal hernia is reduced by drawing the tissues together in the middle line. The cardinal principle of this method depends for its success on employing the support of the aponeurotic pelvic fascia which invests the rectocele in the plane between the vaginal and rectal walls. Hence this method resembles in principle the various operations for hernias involving the abdominal wall. There are numerous modifications of the central type of perineoplasty. Of these, we have found the technic used by Dr. J. G. Clark especially practical.

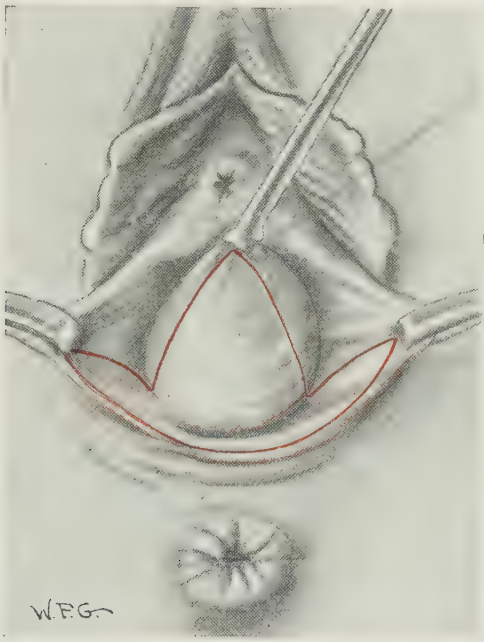


FIG. 319.—CLARK'S PERINEOPLASTY.
Outline of area of denudation. The line from the lateral tenacula to the central tenaculum is not straight, but forms an angle into the sulcus on each side.

**The Operation.**—The field of operation is exposed by grasping the sides of the introitus at the Bartholin openings with Teale's tenacula. A tenaculum is then inserted in the posterior wall of the vagina at a central point two-thirds the distance from the introitus to the cervix. When traction is made on the three tenacula thus placed the field of operation is thoroughly exposed and the outline of the area to be denuded is marked out with a scalpel as in Fig. 319.

A distinctive and important feature of the denudation is the creation of the two angular flaps of vaginal tissue which may be seen in the illustration to have

[1] The drawings illustrating Dr. Clark's method of performing anterior colpoplasty and perineoplasty do not strictly accord in a few minor details with Dr. Clark's technic. Owing to the haste in publication there was no opportunity to make the necessary changes in the drawings.

their apices in the lateral sulci at the sides of the rectocele. By leaving these angular flaps the vaginal mucous membrane may be coaptated in the median line without undue tension, and hence with little danger of causing the formation of obstructing vaginal bands.

When the area thus outlined has been thoroughly and deeply denuded the two angular flaps are dissected free as in Fig. 320 in order to give greater opportunity for carrying out the next step of turning in the hernial protrusion of the rectocele.

In implicating the rectocele a running Cushing stitch of No. 0 chromicized catgut is carried from the upper angle of the denuded area and continued outward

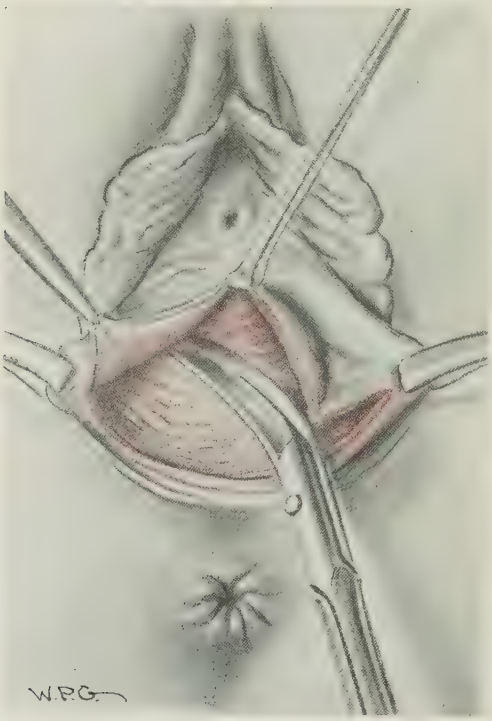


Fig. 320.—Clark's Perineoplasty.
Denudation of the area and freeing of the anuglar flaps.

toward the operator sufficiently far to include the whole of the hernial protrusion. In placing the Cushing stitch it is of great importance to include the aponeurotic fascia which is found to be of definite strength and thickness on the sides of the protruding mass. When this buried running stitch has been placed and tied the mucous membrane of the vagina is coaptated by interrupted sutures of No. 1 chromicized catgut beginning at the upper central angle of the denuded area. These stitches are placed as firmly in the tissues as possible so as to reinforce the buried stitch, but not deeply enough to injure the rectal wall. When the apices of the angular flaps are reached the remaining stitches are placed very deeply

and well out on the sides in order to include the separated bellies of the levator ani muscles. The interrupted sutures are consecutively introduced until the points of entrance of the Bartholin glands are reached. All the interrupted stitches are then tied. The last step of the operation consists in uniting the muscles of the external perineum by a return buried catgut stitch of No. 0 catgut placed in the following manner:

A tenaculum seizes the edge of the external wound at a point equidistant from the two lateral retraction tenacula. By drawing the middle tenaculum sharply downward the denuded surface of the external perineal wound is exposed in the

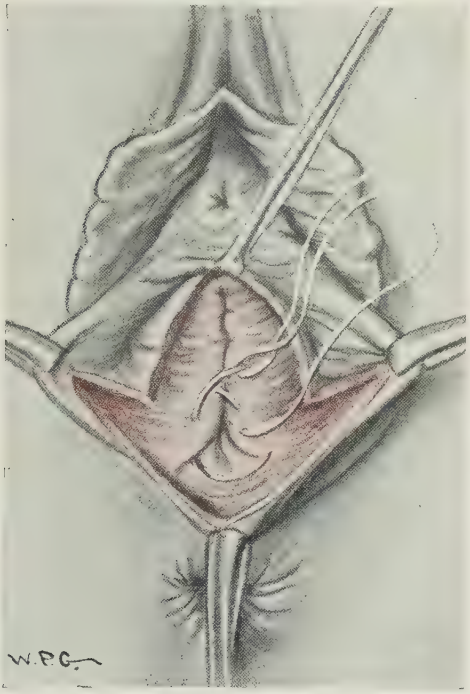


FIG. 321.—CLARK'S PERINEOPLASTY.

The area has been denuded and the angular flaps in the sulci freed. The central part of the rectal hernia is being infolded by a buried Cushing stitch. This stitch is passed into the fascial tissue which invests the rectal wall between vagina and rectum.

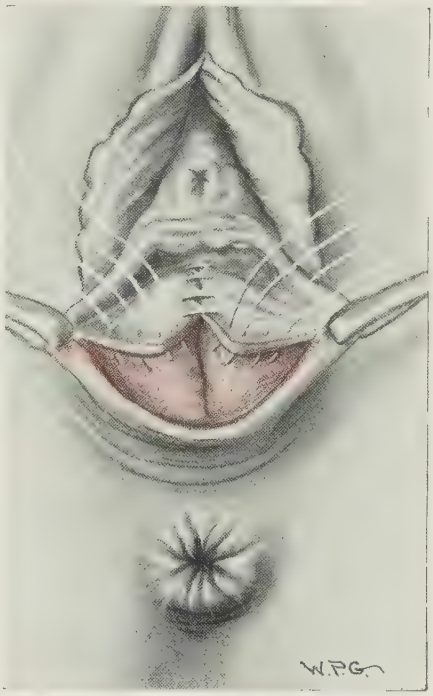


FIG. 322.—CLARK'S PERINEOPLASTY.

Insertion of central stitches. The last four stitches are placed deeply in the bellies of the levator (pubococcygeus) muscles.

form of a triangle with the apex toward the sphincter. A catgut suture is introduced near the duct of the left Bartholin gland and carried deeply into the tissues, including the muscular masses of the levator ani and transversus perinei muscles. It is passed from side to side in the same manner as a Cushing stitch and continued to the lower angle of the exposed area. Having reached this point it is then returned in the reverse direction, more superficially but still placed

sufficiently deep to secure not only an exact coaptation of the skin edges, but also a firm union of the subcutaneous tissues. Having reached on its return journey the level of the introitus, the stitch is carried outward through the vaginal mucous membrane near the duct of the right Bartholin gland. When the two free ends (Fig. 324) are snugly tied the external perineum will be found to be neatly closed without the exposure of a knot.

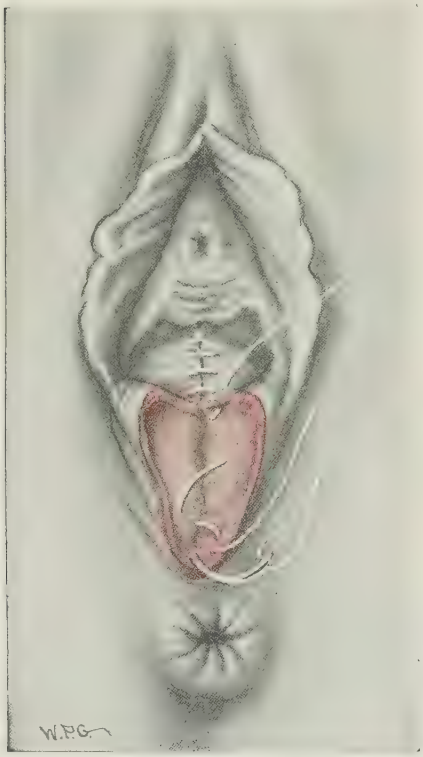

Fig. 323.—Clark's Perineoplasty.

The central stitches have been tied and cut. A buried Cushing stitch has been started at the upper end of the external wound and carried deeply on each side to the lower end of the wound. It is now continued as a subcuticular stitch to the point whence it started.

Fig. 324.—Clark's Perineoplasty.

The subcuticular stitch is just being finished. When tied the external wound is completely closed without exposure of the knot.

**Operation for Complete Tear.**—When the perineal tear involves the sphincter ani muscle the first part of the operation is carried out in every way as above up to the point where the buried stitch of the external perineum reaches the limit of its outward journey. At this point the stitch is tied and cut. The denudation of the skin of the external perineum is then extended as in Fig. 325 so as to expose the ends of the torn sphincter. A new buried catgut suture is next placed at the point where the first was tied, and cut and continued downward, being placed deeply on each side close to but not including the rectal mucous membrane.

By drawing the stitch tight when it reaches the external skin of the anus the ruptured mucous membrane of the rectum will be approximated without exposure of the stitch. The buried stitch is now clamped while the next step is carried out. This consists in securing with tenacula the ends of the torn sphincter and drawing them prominently out to view. The sphincter ends should be dissected clean

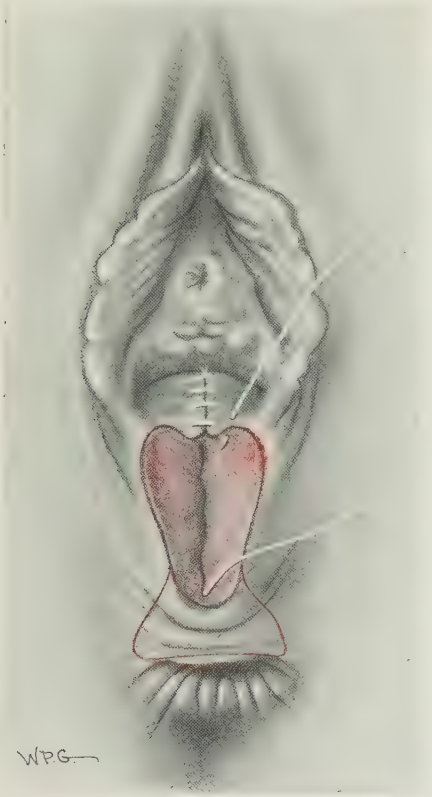


FIG. 325.—CLARK'S PERINEOPLASTY FOR COMPLETE TEAR.

The first part of the operation is performed as for a simple tear. The area for exposing the ruptured ends of the sphincter is outlined and denuded. In the above drawing the buried catgut Cushing suture approximating the levator muscles is represented as having been already introduced. It is better not to introduce this suture until the ends of the sphincter have been secured, as in Fig. 326.

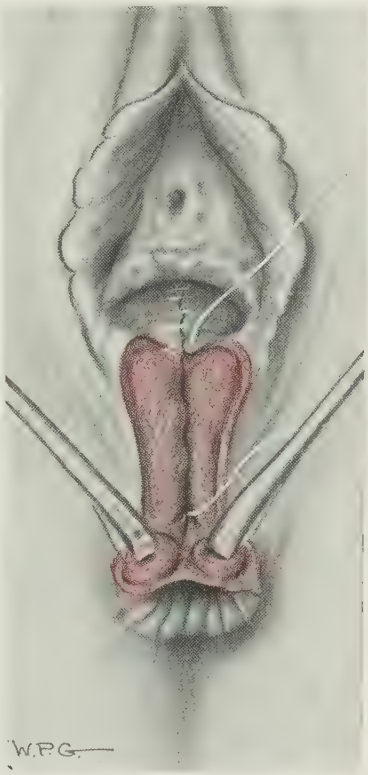


FIG. 326.—CLARK'S PERINEOPLASTY FOR COMPLETE TEAR.

The ends of the sphincter have been secured by tenacula. The buried Cushing stitch has been applied. It is best to tie the buried suture at this point and to continue later with a new stitch as will be seen in Fig. 327.

of scar tissue so that they may be approximated freely and without tension. Three interrupted catgut sutures No. 0 are placed so as to unite the ends firmly together (Fig. 327). The buried catgut suture is then continued as in the operation for simple tear, and when tied with the free end at the introitus (Fig. 328) completes the operation.

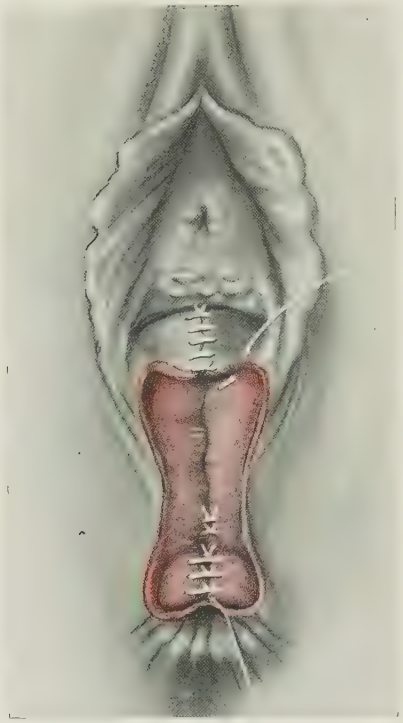

FIG. 327.—CLARK'S PERINEOPLASTY FOR COMPLETE TEAR.

The first buried stitch has been placed and tied. A second buried stitch is then introduced and continued so as to approximate the torn edges of the rectal wall. The end of this stitch is seen in the drawing extruding beneath the sphincter muscle and is to be used as a subcuticular stitch to close the wound. After the buried suture has been placed the ends of the sphincter are brought together and united by three interrupted catgut sutures as shown in the drawing.

FIG. 328.—CLARK'S PERINEOPLASTY FOR COMPLETE TEAR.

The buried suture seen with its end free in the lower part of the previous drawing has been continued as a subcuticular stitch and is about to be tied to the free end of the first buried suture. When these ends are tied the wound of the external perineum is closed without the exposure of a knot.

## STUDDIFORD'S PERINEOPLASTY[1]

The operation elaborated by Studdiford for the repair of the lacerated perineum is studiously based on the exact anatomy of the parts.

Before attempting to follow the steps of the operation the reader should refer to Studdiford's description of the anatomy and function of the perineum quoted in detail in Part II of this book.

Tenacula are applied at the caruncles which mark the openings of Bartholin's glands. Strong outward traction on the tenacula brings into prominence the mucocutaneous border of the posterior vaginal wall. A Kocher forceps or tenaculum is then inserted at the apex of the tab of mucous membrane which is always outlined between the two lateral sulci of the vagina. This point is often marked by an isolated caruncle. The mucocutaneous border is incised from tenaculum

[1] The illustrations of this operation were made from sketches drawn while watching Dr. Studdiford operate. Owing to the necessity of haste in publication there was no opportunity to submit the finished drawings to Dr. Studdiford for inspection.

to tenaculum and the tissues freed by blunt dissection with scissors. Scar tissue will be found on each side corresponding to the two lateral sulci. These scars are first nicked with scissors and an opportunity given to insert the finger into each sulcus beneath the vaginal mucous membrane. With the forefinger in the sulcus the scar may be readily brought into view by upward pressure on the vaginal mucous membrane (Fig. 329). The scar tissue of each sulcus is excised in the manner shown in Fig. 330. The denuded area is now similar in outline to that

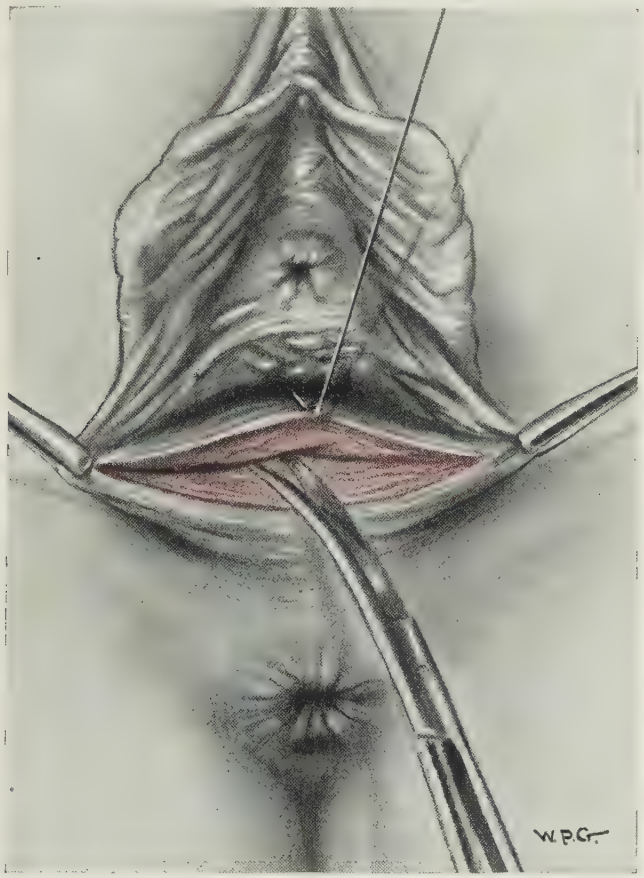


FIG. 329.—STUDDIFORD'S PERINEOPLASTY.

Initial incision. Tenacula have been applied at the caruncles and drawn outward. The mucocutaneous border has been incised. The tissues are being separated by blunt dissection with scissors.

of the Emmet operation except that the two wings of the area are asymmetric on account of the difference that usually exists in the extent of the two lateral scars.

The perineal muscles and trigone are next developed, obstructing scar tissue being dissected away. The muscles are not bared to their muscle-fibers, but are brought to view in their fascial investments. The deep sutures are now placed.

A suture with needle at each end is started at the rectal protrusion surmounted by the central vaginal tab. The needle is then passed very deeply into the pubo-

coccygeus muscle of the one side *behind and not including the trigone*. The needle of the other end of the suture is then carried into the belly of the other pubo-coccygeus muscle. The final course of the suture is to include the anterior end

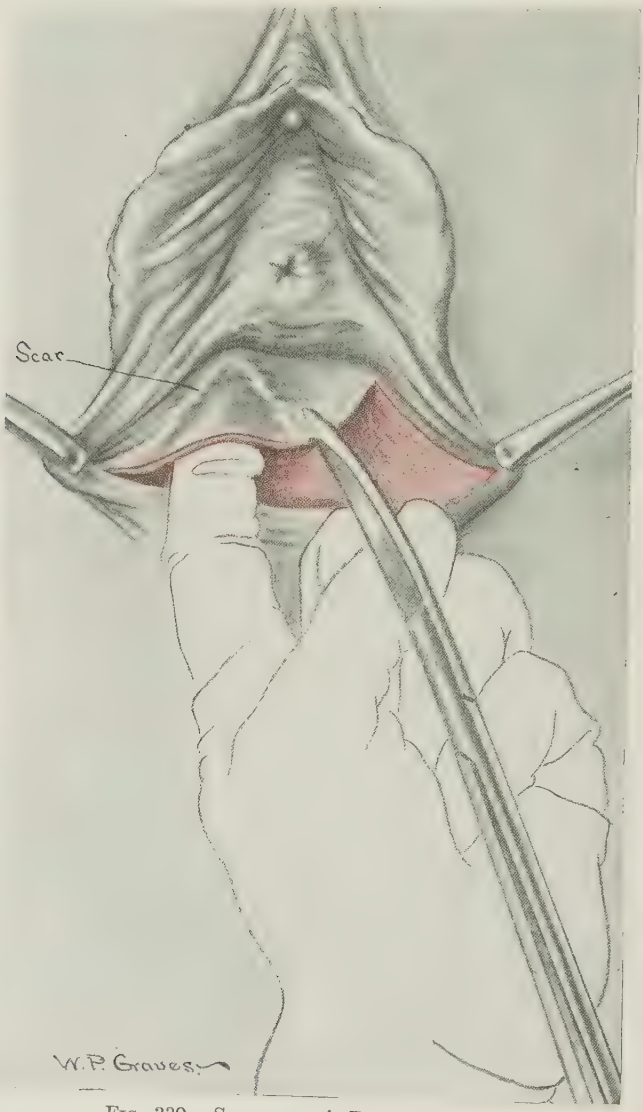


FIG. 330.—STUDDIFORD'S PERINEOPLASTY.

Exposure of the lateral sulci. The vaginal mucous membrane is freed in the two sulci by forcibly inserting the forefinger beneath the scars. The scar tissue is cut away as in the drawing. The mucous membrane of the left sulcus has been removed. That on the right is about to be incised. The final appearance is similar to that of the denudation of Emmet's perineoplasty.

of the sphincter muscle, that end of the suture being applied which will best draw the sphincter toward the side on which the laceration was deeper. A second deep suture is applied in the same manner.

The next step is to close the lateral sulci which have been thus exposed.

This is done with a running subcuticular Cushing stitch starting from the apex and extending to the base of each lateral triangle, care being taken to secure as far as possible the investing fascia. (In the drawings this step precedes the placing of the deep stitches.) When the subcuticular sutures have been tied the stitch of the left side is passed through the upper end of the right trigone and the stitch of the right side is passed through the upper end of the left trigone

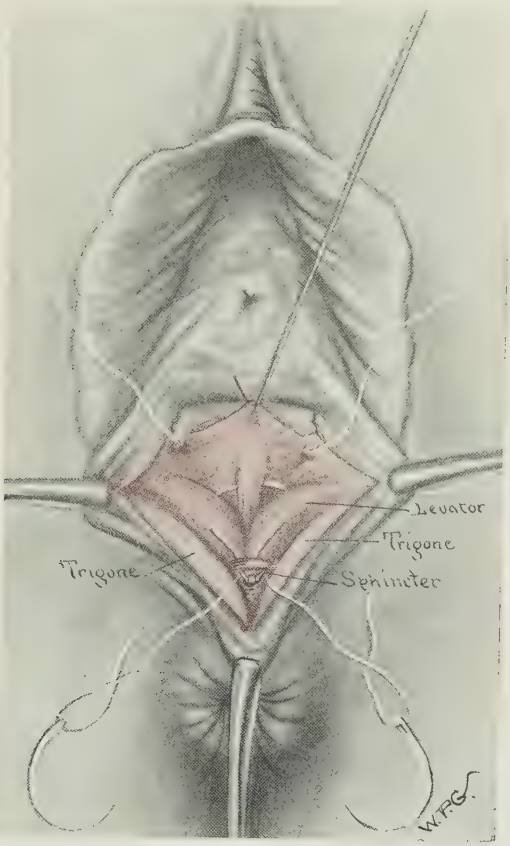


FIG. 331.—STUDDIFORD'S PERINEOPLASTY.

Approximation of the pubococcygeus muscles. The two lateral sulci have been closed by buried Cushing sutures, the ends of which are left long. The bellies of the levator ani muscles are being united by two buried sutures. One suture has already been placed and tied. The second suture is being placed. The suture is equipped with a needle at each end. A bit of tissue is first included in the median line under the central tongue of mucous membrane. It is passed on each side deeply into the levator pubococcygeus muscles *behind the trigone*. The upper fibers of the sphincter ani muscle are included in the suture.

(Fig. 332). The two sutures are tied and kept long. This unites what may be termed the crown of the perineum. The two ends of the united suture are then used to close the external wound. One end unites the edges of the trigone, and is returned as a subcuticular stitch to approximate the skin edges. The two ends are then tied in such a way as to bury the knot.

If there is marked rectocele present special measures must be taken. In

case of high rectocele Studdiford advocates a central incision through the mucous membrane of the posterior vaginal wall. The vagina and rectum are separated widely on each side of the central incision. When the rectum has been well mobilized the hernial protrusion is implicated by a running stitch, as in Clark's operation. The excess of vaginal mucous membrane is trimmed, if necessary, and coaptated, preferably by interrupted catgut sutures. The rest of the operation is then carried out as described above. Studdiford, like Clark and others, recommends in addition to the plastic operation for rectocele the prin-

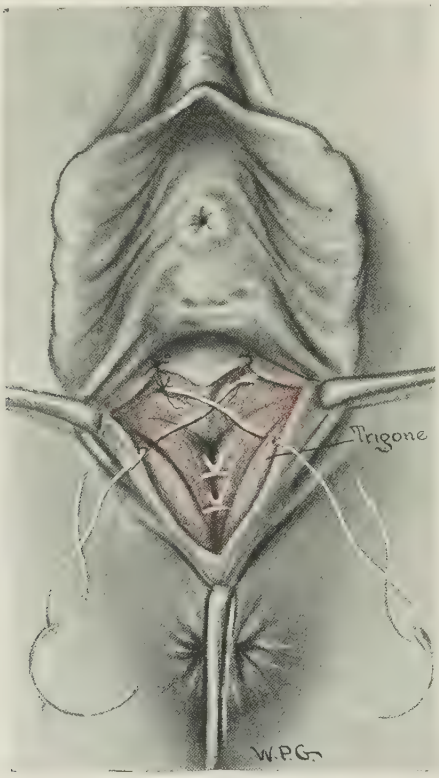


Fig. 332.—Studdiford's Perineoplasty.

Approximation of the trigone. The pubococcygeus muscles have been united by two buried sutures which have been tied and cut. The long ends of the Cushing sutures which have closed the lateral sulci are now employed to unite the trigone. Each suture is crossed over and inserted in the upper end of the trigone. The ends are then firmly tied, thus bringing the upper ends of the trigone together and in relation to the central tongue of mucous membrane.

ciple of closing the posterior culdesac through an abdominal incision. This may be accomplished either by the Moschowitz technic for rectal prolapse or by the author's modification described on page 692.

If the rectocele is low, the levator ani muscles (pubococcygei) are brought together in the median line as high up as possible, so as to interpose them between the rectum and vagina. This is the principle employed in the so-called central operations of which Holden's operation (*q. v.*) is a type.

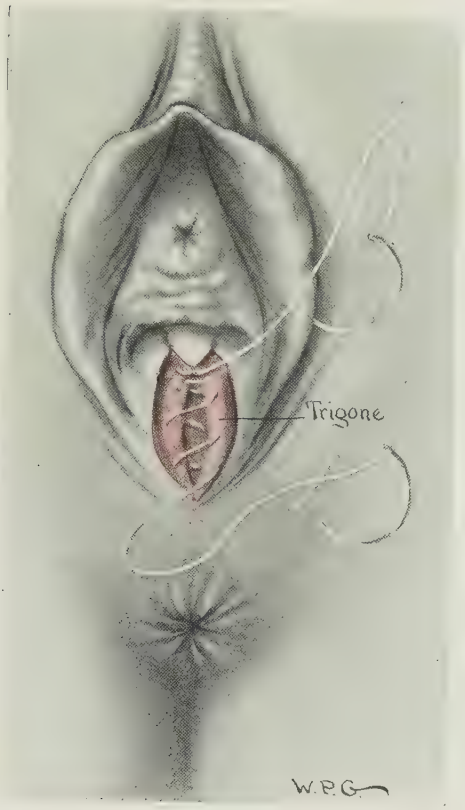


FIG. 333.—STUDDIFORD'S PERINEOPLASTY.

Closure of the external perineum. The sutures which were inserted in the upper ends of the trigone have been tied and the ends still left long. One suture is then continued downward so as to approximate the sides of the trigone. After reaching the lower limit of the wound it is then returned as a subcuticular stitch to the point whence it started. It is then tied to the other suture. In this way the wound is closed subcutaneously and without the exposure of a knot.

## OBLITERATION OF DOUGLAS' POUCH FOR RECTOCELE (AUTHOR'S METHOD)

In severe cases of rectocele the most painstaking and apparently effective perineoplasty is sometimes followed by a recurrence. This is due to a deepening of the pouch of Douglas caused by the expanded rectum, so that even when the perineal muscles remain intact the surgeon may find in the course of time that a hernial protrusion is beginning to roll out over the perineal dam under the influence of abdominal pressure. Such recurrences usually do not become severe nor do they often cause serious subjective symptoms. Nevertheless, the reappearance of a lump in the vagina is disconcerting and annoying to the patient and a source of chagrin to the surgeon. Several operators, notably D. F. Jones and J. G. Clark, have successfully obviated this difficulty by the use of the Moschowitz operation originally designed for prolapse of the rectum. We have also employed this operation for the prevention of recurrent rectocele and found it of practical value. In a complicated reconstructive operation, however, we have found the Moschowitz technic somewhat long and tedious, and we have,

therefore, devised the following rapid method of obliterating the pouch of Douglas and have had results equally as good as with the Moschowitz operation. We recommend it *only for cases of rectocele and not for rectal prolapse.* The operation is to be used in connection with some form of suspension of the uterus or with the method of operating for procidentia in which, following supravaginal hysterectomy, the cervical stump is attached to the anterior abdominal wall.

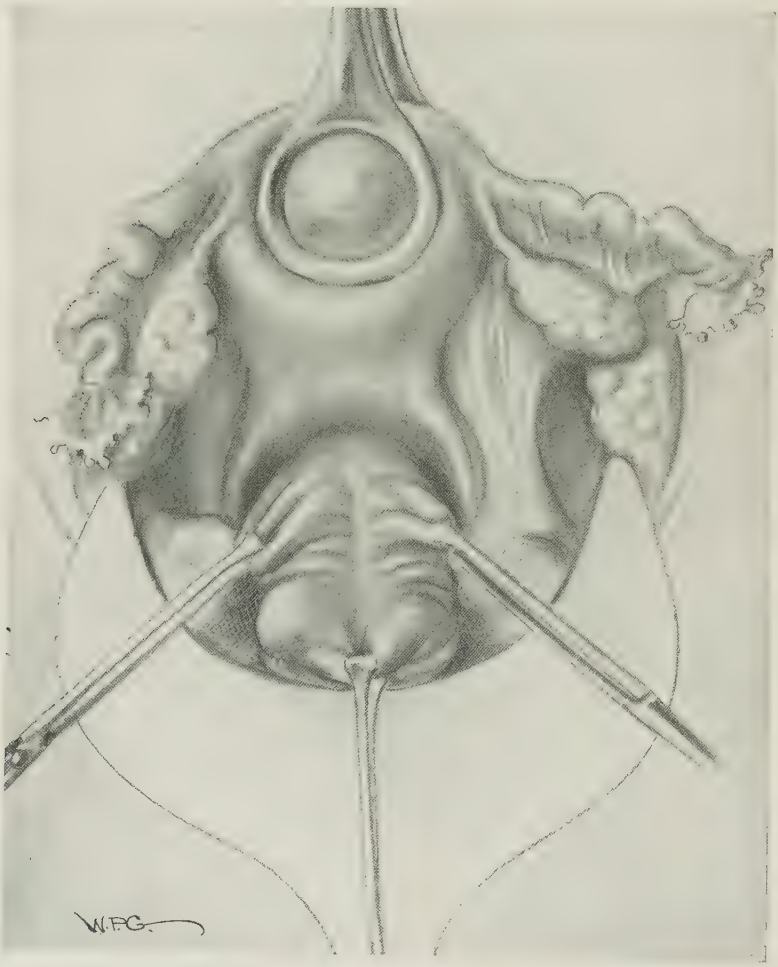

FIG. 334.—CLOSURE OF DOUGLAS' POUCH (AUTHOR'S METHOD).

The uterus is drawn upward and forward as far as possible. The sides of the rectum are seized with Allis' clamps at the points where the uterosacral ligaments join the sides of the rectum. The clamps are inserted into the pararectal tissue rather than into the rectal wall itself. The clamps are then brought up to the posterior wall of the cervix just above the origins of the uterosacral ligaments. Sutures passed into the uterus and through the pararectal tissue suspend the rectum to the posterior wall of the cervix at these two points.

The patient is placed in a steep Trendelenburg position. The intestines are packed back with gauze sponges, leaving only the rectum to be seen in the pelvis. The uterus is drawn upward and forward as far as possible so as to give a good view of the pouch of Douglas. In cases of marked rectocele the pouch will be

found abnormally deep. The course of the uterosacral ligaments is then observed, and at the points where they join the rectal wall Allis' clamps are applied. It will be found that the clamps may be set firmly into the pararectal tissue without including the rectal wall, and that when traction is exerted on the clamps the rectum may be lifted under considerable tension without danger of tearing the

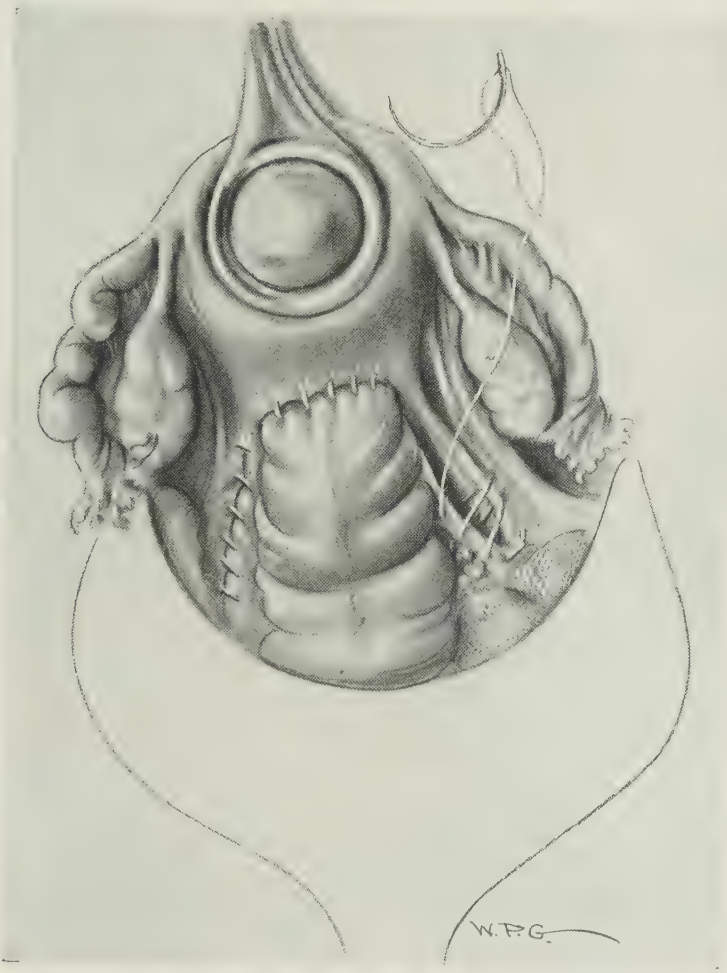


FIG. 335.—CLOSURE OF DOUGLAS' POUCH (AUTHOR'S METHOD).

The openings made by the loops of the uterosacral ligaments are being closed by running sutures. The closure on the left has been completed; that on the right is being completed. Interrupted sutures attach the wall of the rectum to the posterior wall of the cervix.

rectal wall. By drawing upward on the two Allis clamps the anterior wall of the rectum is then lifted to as high a point as possible on the back of the uterus. This point is usually at about the level of the uterine attachments of the uterosacral ligaments. Two sutures are then placed through the pararectal tissues included in the clamps and into the uterine wall. The sutures are tied and the ends left long to serve as tractors. Thus at this stage it will be seen that the

rectum is drawn tightly up and suspended by two sutures to the back of the uterus. On the sides it will be observed that each uterosacral ligament forms a loop making a corresponding opening into the posterior culdesac. The two openings are closed by running catgut sutures. So far no sutures have entered the wall of the rectum. It is now necessary to attach the rectum to the uterus by placing interrupted sutures from rectum to uterus between the two traction stitches. In placing these stitches it is necessary to enter the muscularis and submucosa of the rectal wall in order to secure a firm attachment of adhesions to the uterine surface. When the stitches have all been placed it will be found that the posterior culdesac is completely shut off. The uterus or cervical stump is then attached to the anterior abdominal wall, an attachment which serves to support the rectum. There is no danger of obstructing the lumen of the bowel.

### ENLARGING A TIGHT PERINEUM

In enlarging a perineum that has been sewed too tightly, or that has shrunken from senile atrophy, it must be remembered that the stricture is due to a cicatricial contraction of the superficial parts of the perineum, and not to a too close union of the muscles, which we have seen is impossible.

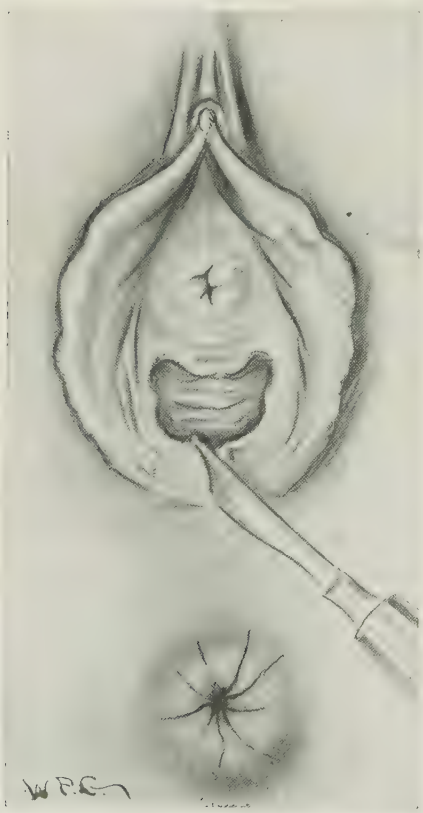

Fig. 336.—Enlarging a Tight Perineum. A transverse incision is made through the sharp cicatricial posterior fold of tissue.

Usually a sharp unyielding band of tissue is felt at the introitus, distention of which causes pain or discomfort. The operation aims to do away with this obstructing band and to create a funnel-shaped elastic introitus. This may be done as follows: A transverse incision is made through the scar (Fig. 336). All the unyielding cicatricial bands are then dissected out subcutaneously through the initial incision (Fig. 337). The wound is sewed in a direction at right angles to the way in which it was incised (Fig. 338). If other separate cicatricial bands or cords are found inside the vagina they are to be treated in the same way. It is a significant fact that the perineal wounds following this operation heal with some difficulty, owing to the deficient blood-supply to the wound. The after-care is, therefore, very important. It is inadvisable to undertake this operation, simple as it seems, without full anesthesia.

FIG. 337.—ENLARGING A TIGHT PERINEUM. Cutting out the scar-tissue by subcutaneous dissection with scissors.

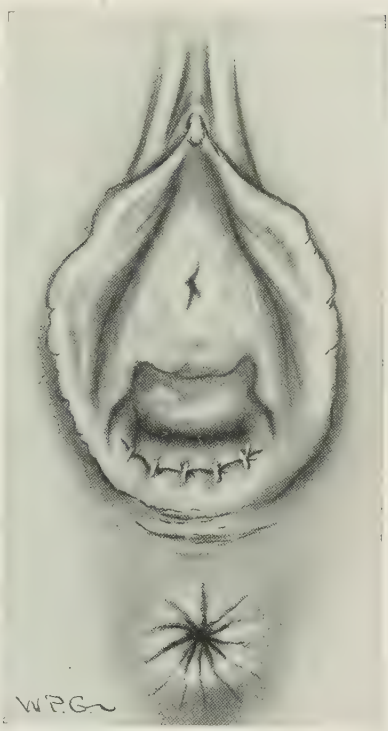

FIG. 338.—ENLARGING A TIGHT PERINEUM. Wound closed, leaving funnel-shaped introitus.

## OPERATION FOR COMPLETE LACERATION OF THE PERINEUM

In operating for perineal tears through the sphincter the principles of the Emmet method are recommended, with modifications to suit the circumstances and the individual technic of the operator. The following is the technic employed by the writer:

The patient is given a very thorough bowel preparation, beginning the second day before the operation. Before beginning the operation it is well to pack the rectum with a narrow strip of gauze to prevent the escape of feces.

The first part of the operation is performed exactly like the first step in the ordinary perineoplasty—*i. e.*, the lateral sulci are denuded and sutures placed, uniting the anterior portion of the levator ani muscles (puborectales) to the sides of the rectum. This in some cases is unnecessary, for it often happens that the perineal separation is entirely in the median line along the raphé uniting the lower bellies of the levators, and not at all along the sides of the rectum. This is usually the case when the rectovaginal septum is ruptured for any considerable distance. When there is no separation in the lateral sulci and no extensive tear of the septum a simple median denudation is used with catgut approxima-

tion from side to side, care being taken not to make the introitus too tight. If there is extensive rupture of the rectovaginal septum a special technic is required (see below):

The type of case most commonly seen is depicted in Fig. 339. When the internal vaginal part of the operation is finished, the two last catgut sutures

Fig. 339.—Operation for Complete Laceration of the Perineum.

The internal part of the perineum operation has been completed. The red line indicates the outline of the area to be denuded from the external perineum. It is carried below the dimples that mark the position of the sphincter ends. This denuded area should not be made so wide that the skin edges cannot be approximated without too much tension.

which close the lateral sulci are left long, clamped together, and held firmly upward by an assistant for the remainder of the operation. The area of denudation of the external perineum is now outlined. Beginning at the Bartholin duct of the left side, a light mark is made in the skin with the scalpel down to the dimple which indicates the retracted end of the sphincter muscle. This line should be curved slightly inward. On reaching the dimple the line is carried around it, and across to the dimple that represents the other end of the torn sphincter. This transverse incision skirts along the edge of the connective-

tissue bridge which usually forms between the sphincter ends, and should be made at the junction of the skin and mucous membrane of the bowel (Fig. 339).

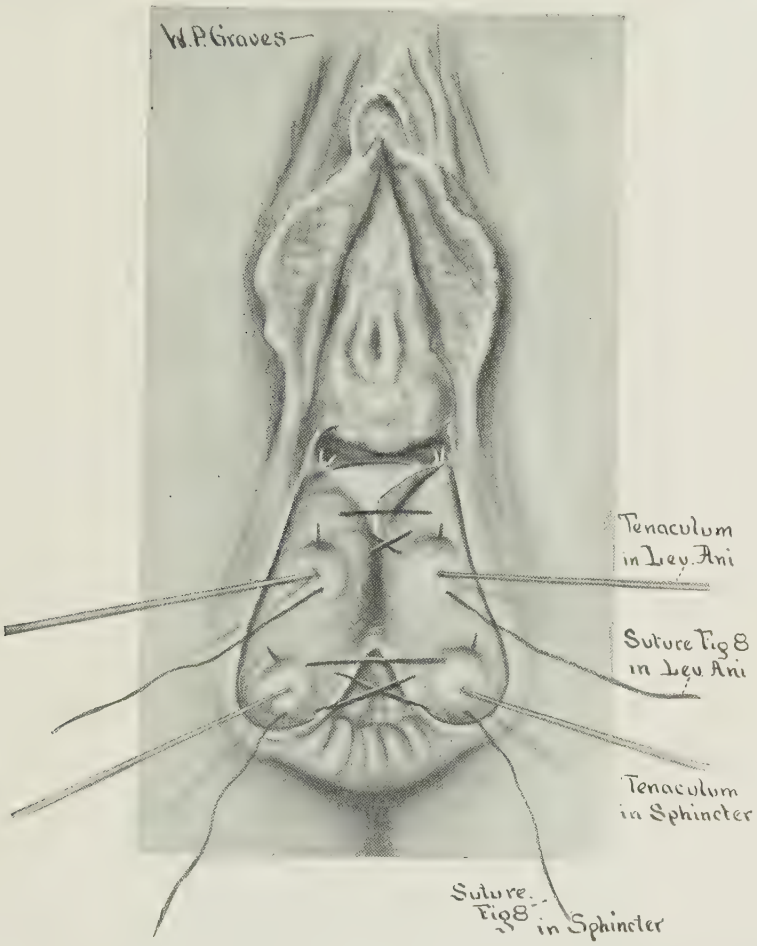


FIG. 340.—OPERATION FOR COMPLETE LACERATION OF THE PERINEUM. (Author's technic.)

The field of operation has been exposed by the denudation outlined in Fig. 339). The levator muscles are then transfixed with tenacula and brought to view. A figure-of-8 catgut suture (No. 0) is placed as in the drawing. The ends of the sphincter muscle are transfixed and exposed in the same way. An approximating buried catgut figure-of-8 stitch is also placed in the ends of the sphincter muscle. Deeply placed silkworm-gut sutures are then introduced from side to side beginning at the top, as in the Emmet operation. The two buried catgut sutures are not tied until all the silkworm-gut sutures are placed.

On reaching the dimple of the right side the line of demarcation is carried around the dimple and up to the Bartholin duct of that side. It is of very great importance that the figure thus outlined should be exactly symmetric, for if it is not, the edges of the wound when brought together from side to side will not match. Care should be exercised also in making the vertical lines not to draw them too far apart, otherwise the wound edges when brought together will be under too great tension.

When the figure has been satisfactorily marked out, the intervening skin is removed with Emmet's scissors. All scar-tissue is dissected away until all the parts involved in the operative field are soft and plastic. Tenacula are now introduced deeply into the bellies of the separated levators, and held so as to bring the muscles boldly into view. Two other tenacula seize the ends of the sphincter muscle and expose them in the same manner (Fig. 340). Figure-of-8 sutures of No. 0 chromicized catgut are then placed in both the levator and

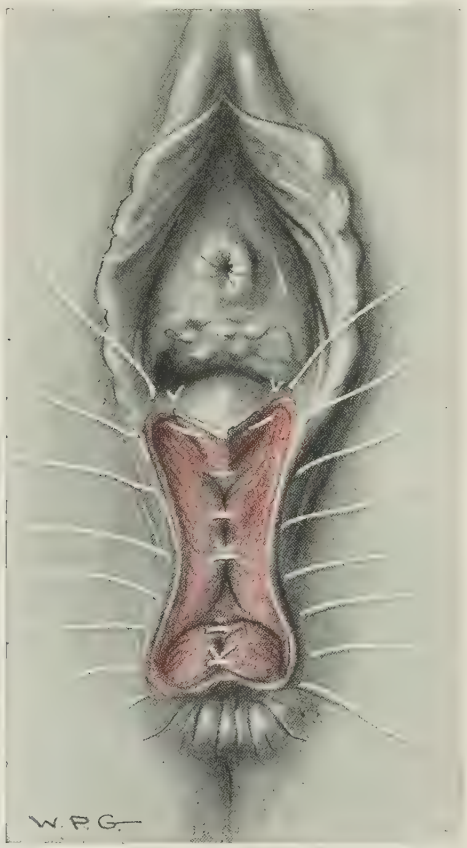


Fig. 341.—Operation for Complete Laceration of the Perineum. (Author's technic.)

The two buried figure-of-8 catgut sutures have been tied, one approximating the levator ani muscles and the other uniting the ends of the sphincter muscle. The silkworm-gut sutures have been placed and are ready to be tied.

sphincter muscles, the suture ends being left long and not yet drawn taut. Beginning then at the top of the wound wilkworm-gut stitches are placed deeply into the fibers both of the levator and sphincter muscles. In crossing from one side to the other over the chasm made by the laceration the silkworm-gut stitches issue from and enter at the very edge of the rectal mucous membrane, but not including it.

When all the stitches have been properly placed the two figure-of-8 stitches which are to be buried are tied firmly, but not too tightly, and the ends

cut short. The silkworm-gut sutures are then tied, beginning at the anal end, the ends cut and shotted (Fig. 342). The success of the operation depends chiefly on an exact approximation of the sides of the wound without undue tension, for if this is not attained, non-union, sepsis, and greater or less destruction of the wound are almost sure to ensue.

Fig. 342.—Operation for Complete Tear of the Perineum.
The silkworm-gut sutures have been tied, cut, and shotted.

During convalescence the wound requires unremitting attention with expert nursing, under the utmost antiseptic precautions. The bowels are kept closed for from nine to twelve days and then moved with oil catharsis. The external stitches are removed on the ninth day. If a stitch shows signs of infection before that, it is best to remove it. Catgut for the external stitches is interdicted.

When the tear extends far up the rectovaginal septum, the denudation of the vaginal portion is central and not in the lateral sulci. The denudation

begins above the upper angle of the wound, and is carried down on either side to the Bartholin ducts. Only a small amount of vaginal tissue should be removed in the region of the introitus, for if this precaution is not observed there is much danger of closing the perineum too tightly.

Fig. 343.—Operation for Complete Laceration of the Perineum. (Warren's "apron" method.[1])

The sphincter muscles are exposed by turning down a flap which, when sewed up, is supposed to prevent the wound from contamination by the bowel. The operation is not applicable when the rectovaginal septum has been torn.

The surest results are gained by using silkworm-gut to close the vaginal part of the wound, notwithstanding the annoyance of having to remove them later, catgut not being dependable in these cases. Buried rows of catgut sutures, closing the wound in layers, seem at the time of operation to unite the wound with great strength, but the catgut is treacherous, and in the long run the results from its use are inferior to those where the hard, non-absorbable suture has been employed.

*Rectovaginal fistula* is usually associated with a tear through the sphincter

[1] The principle involved in the apron operation was devised by Dr. J. Collins Warren of Boston, whose paper on the subject, entitled "New Operation for Rupture of the Perineum through the Sphincter," was published in the Transactions of the American Gynecological Society for 1883.

muscle, and is due, as a rule, to the healing over of the intervening tissue. It is often seen in cases in which the attending obstetrician, having repaired the tear immediately after delivery, has secured only partial healing of the wound. Thus, sometimes one sees a rectovaginal fistula where the sphincter has healed completely.

In operating on rectovaginal fistulæ, if the sphincter is competent, it is best to attempt the closure of the fistula by itself, though it is more difficult to cure a single fistula than a lacerated sphincter. If the sphincter is incompetent, it is advisable to cut through the anus to the fistula, making a fresh complete tear.

The fistula operation may be done in layers with one or two rows of buried catgut, or it may be closed with a single row of interrupted non-absorbable sutures, silver wire or silkworm-gut.

We have found the latter method more successful. The opertion is practically identical with that for vesicovaginal fistula. A wide denudation is made in an oval shape about the fistula, the direction of the oval being made longitudinal or transverse, so that the tissues may be brought together from side to side with as little tension as possible. If the wound is to be sewed in layers the rectal mucous membrane is separated from the vaginal membrane for a short distance about the fistulous opening. The membranes are then sewed separately with catgut.

The other and better method is to close the entire wound with silver wire, the sutures being placed well out from the margin of the wound, so that they may act as a sort of splint. (See Operations for Vesicovaginal Fistulæ.)

## OPERATIONS FOR VESICAL FISTULÆ

For vesicovaginal fistula several operations have been devised. For small fistulæ, where there is plenty of healthy tissue about the opening, the *classical*

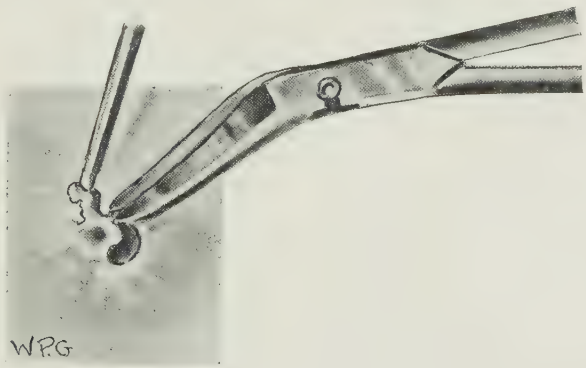


Fig. 344.—Vesicovaginal Fistula.
Dissection of mucous membrane around the fistulous opening.

*operation of Marion Sims* is entirely satisfactory. It is performed in the following way:

The patient is either in the lithotomy or in the Sims position. The latter is sometimes preferable where the fistula is high up toward the vault of the vagina, as is frequently the case when the injury has been done in the process of a hysterectomy. An oval denudation is made with fine scissors about the opening down to the vesical mucous membrane, special care being taken to trim off the cicatricial edge of the bladder opening. The denuded margin about the orifice should be as wide as possible without causing too much tension when the edges

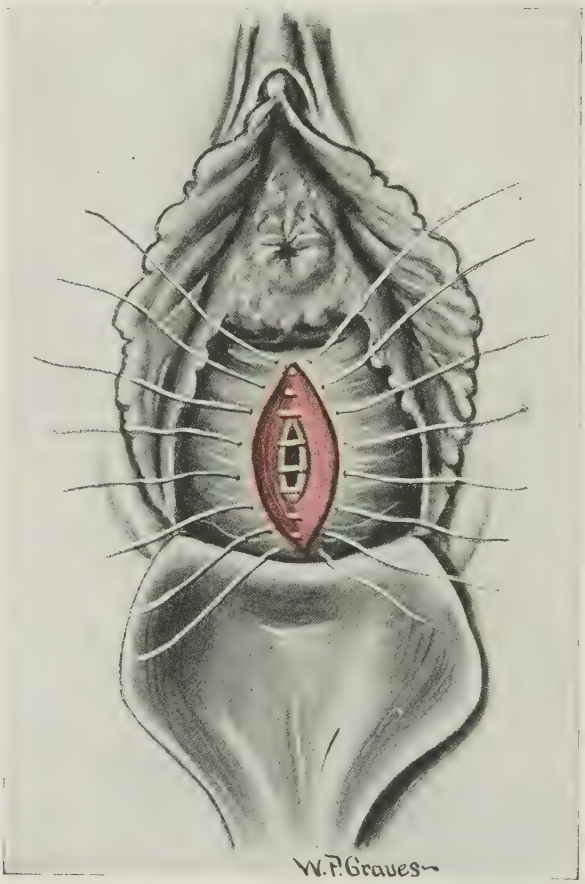


Fig. 345.—Vesicovaginal Fistula.
Wound being sutured longitudinally by the classical method of closure.

are approximated, usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch. The ends of the oval are carried out still further from the opening. The direction of the denuded oval is determined by the individual case, and is made longitudinal, transverse, or even oblique in relation to the vaginal axis, according to which way the tissues can be brought together with the least tension. As a rule, the transverse denudation is the most favorable. When the denudation has been cleanly and symmetrically made, interrupted sutures are introduced from side to side, being carried well into the vaginal tissues and down to the edge of the bladder mucosa,

but not including it (Fig. 345). The suture material is, preferably, fine silver wire, carried by silk guides, which are threaded on fine full-curved needles. It is advisable to begin at the center of the wound and work each way, so that there will be no error in approximating the vaginal mucous membrane that covers the fistula. The stitches should be fairly close together and carried for a considerable distance to each side of the opening, so that even when the fistula is small eight or ten sutures are usually required. The silver-wire

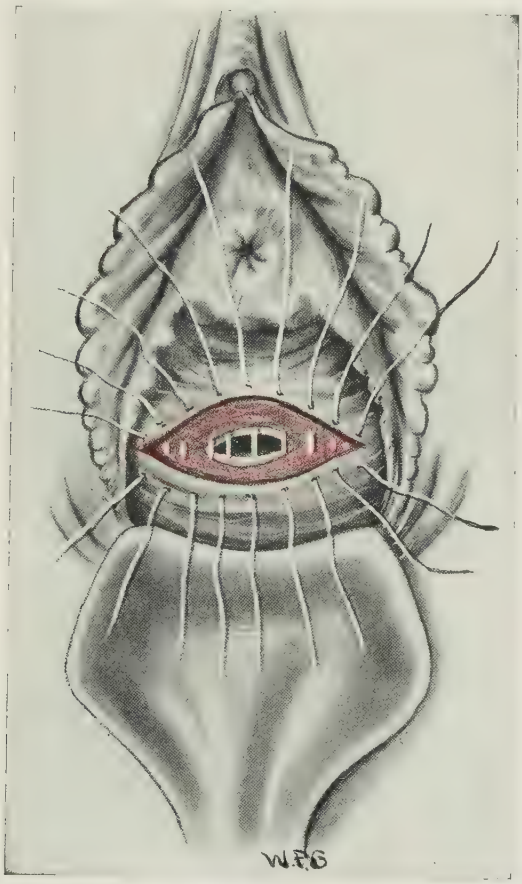

Fig. 346.—Vesicovaginal Fistula.
Wound being sewed transversely by the classical method of closure.

sutures are twisted, bent to one side, and cut off about $\frac{1}{2}$ inch long. They are removed in fifteen to seventeen days. During convalescence for the first week or ten days the patient should not be allowed to accumulate more than 4 ounces in her bladder. Two or three catheterizations may at first be necessary, after which the patient is usually able to urinate voluntarily. Strict watch of the urinations should be kept and the patient wakened at regular intervals during the night. If catheterization is necessary, it should be done only by experienced

hands. If the patient is conscientiously tended in this manner the results are far better than those attained by the use of self-retaining catheters, which should be avoided if possible.

A *second method* for treating vesicovaginal fistula is that of dissection and cleavage of the vaginal and bladder walls, and sewing the wound in separate layers. This method is especially applicable to cases in which there has been a considerable loss of tissue, so that the approximation of the wound edges by

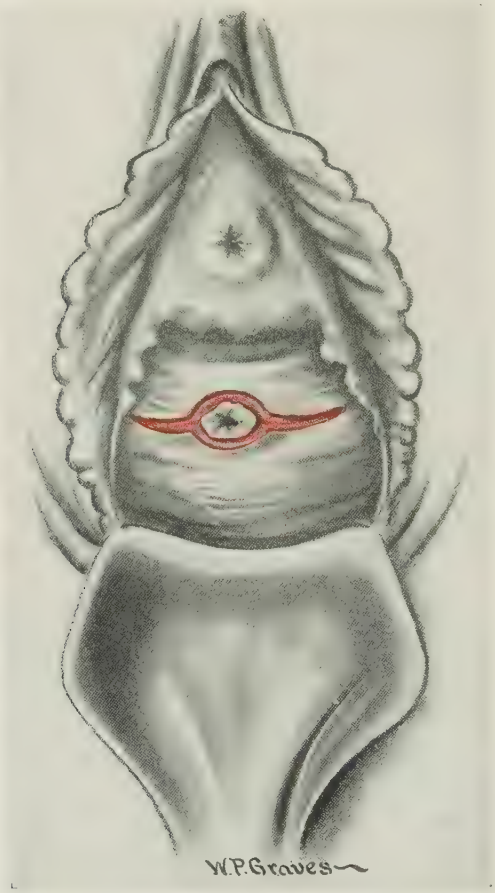


FIG. 347.—OPERATION FOR VESICOVAGINAL FISTULA.
Incision for the method of closing by layers.

the Sims method cannot be accomplished without too great tension. An incision is made with a sharp knife (Fig. 347) and the bladder and vaginal walls separated about the fistulous opening. This dissection is carried out until the edges of the vesical wound can be approximated with forceps without tension. The edges of the bladder wound are freshened by trimming them with scissors.

The vesical layer is closed by a continuous fine catgut suture introduced by the Lembert method. The vaginal plane is closed by interrupted non-

absorbable sutures, preferably of silver wire, applied as in the Sims operation. It is often advantageous to sew the two layers so that the two wounds will not coincide, but cross each other in direction. Sometimes the vesical plane can be closed, but the vaginal flaps cannot be coaptated without too great strain. Kelly's method in this emergency is to sew the vesical mucous membrane of one side of the wound to the combined edges of the bladder and vagina of the

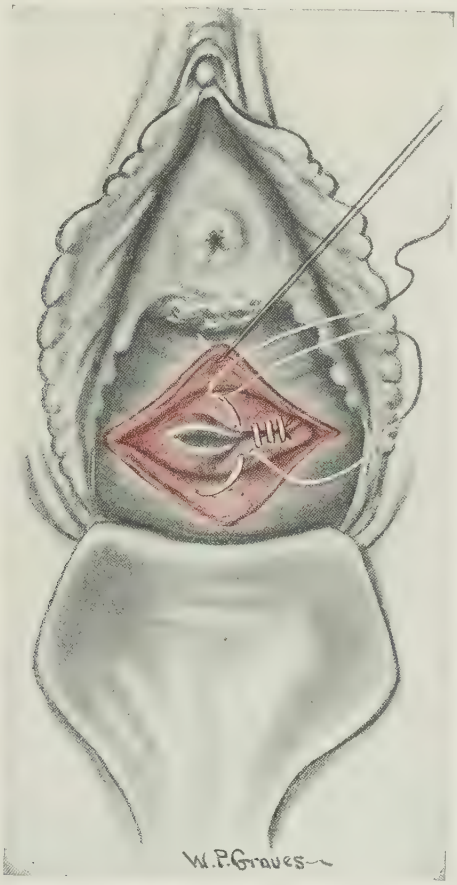


FIG. 348.—OPERATION FOR VESICOVAGINAL FISTULA.

Sewing up by layers. The first line of sutures inverts the vesical mucous membrane. A continuous Lembert stitch of fine chromic gut is employed for the bladder wall. Interrupted silver wire or silkworm-gut sutures close the vaginal wound.

other side of the wound. This leaves a raw area which, Kelly states, is soon covered with epithelium.

A third method of treating vesicovaginal fistula, and one especially recommended by Albarran, is the *operation of Braquehaye*. An incision is made as in Fig. 347, leaving a margin of vaginal mucous membrane about the fistulous orifice. If the fistula is in a position difficult of access, much more room can be gained by making a paravaginal incision, such as is described on page 776 in performing a vaginal hysterectomy for cancer.

The walls of the vagina and bladder are then separated, as in the preceding operation. The small area of mucous membrane left about the fistulous opening is dissected up so as to form a collarette, which is inverted into the bladder. In this way denuded surfaces are in contact with each other at the opening, a condition favorable for closure. The inverted orifice is closed in by a reduplicating continuous Lembert stitch, as shown in Fig. 351. The vaginal mucous membrane is closed by interrupted sutures, as in the two preceding operations, it being advantageous to have the two suture lines cross at an angle.

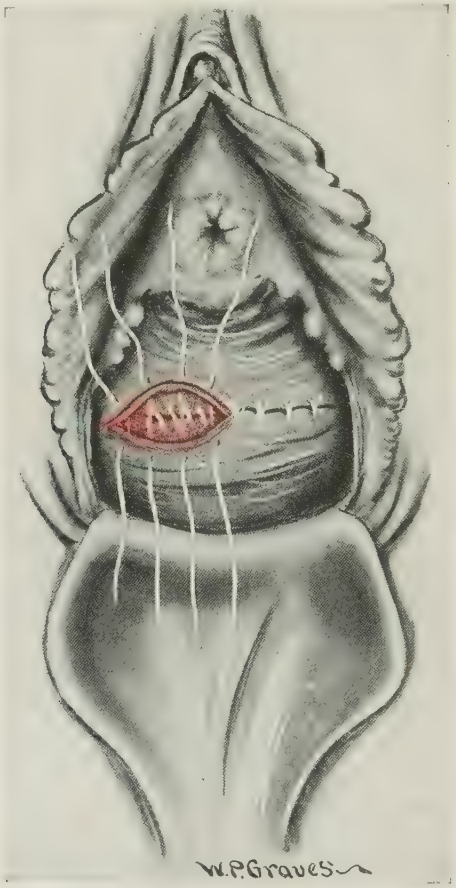


Fig. 349.—Operation for Vesicovaginal Fistula Closure by Layers.
The bladder wall has been sewed with a continuous Lembert stitch of fine chromic gut. The vaginal wall is being closed with silver wire.

In extreme cases, where there has been a profound destruction of the tissues, such as the almost complete disappearance of the vesicovaginal septum, the condition may be treated by closing up the vagina below the opening (colpocleisis). By this method the upper part of the vagina becomes an integral part of the bladder, so that if the patient has not reached the menopause the menstrual blood passes into the bladder. The disadvantages of the operation are obvious.

Vesicocervicovaginal (or juxtacervical) fistula (Fig. 352) cannot be satisfactorily denuded in the manner of vesicovaginal fistulæ described above. In these cases the orifice of the fistula is usually embedded in an immovable mesh of cicatricial tissue, making plastic operations well nigh impossible. The best plan here is to make a transverse incision, and separate the vaginal vault and bladder from the cervix. This exposes the opening in the bladder wall, which may then be closed by a continuous Lembert suture. The method is illustrated in Fig. 356 (adapted from Kelly).

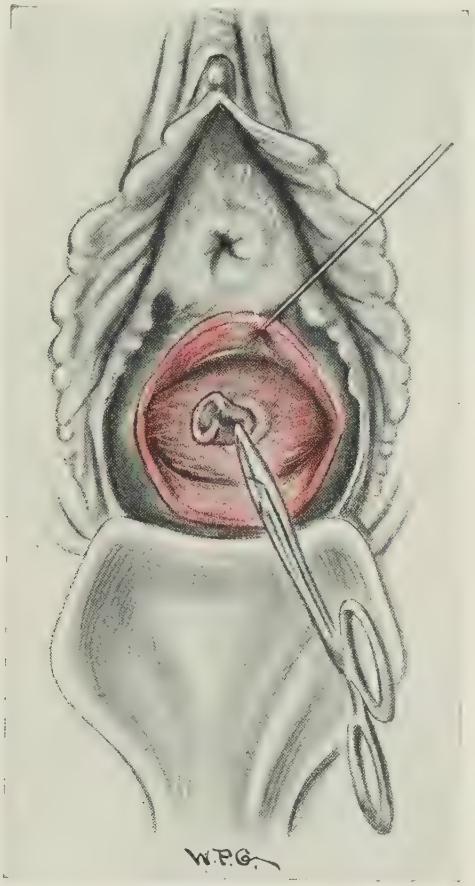


Fig. 350.—Braquehaye's Operation for Vesicovaginal Fistula, Modified by Albarran. Turning in the cuff around the fistula (adapted from Albarran).

In vesico-uterine (intracervical) fistula the opening is into the cervical canal and cannot be seen. The position of the fistula can be determined by introducing one probe into the opening from the bladder and one into the cervical canal, the height of the opening being detected by the clicking of the two metal instruments.

If the opening is low, the fistula may be reached by a transverse vaginal

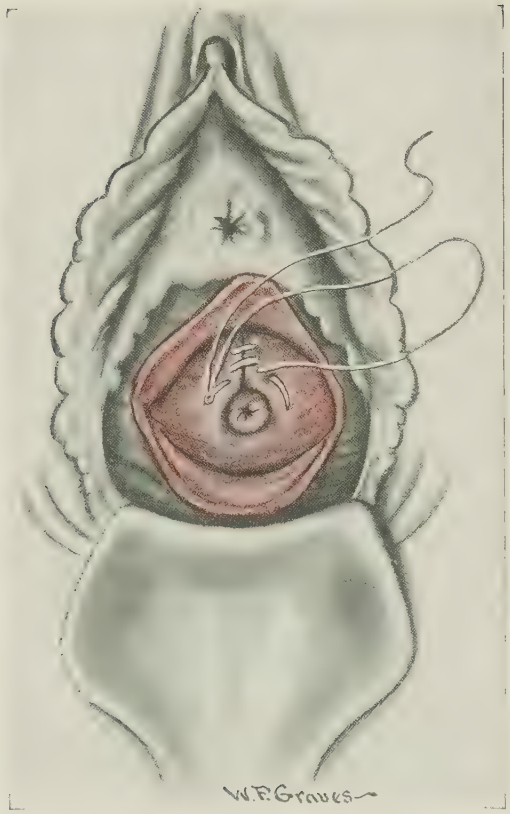


Fig. 351.—Braquehaye's Operation for Vesicovaginal Fistula.
Method of closure. The lines of suture of the two layers will be at right angles.

Fig. 352.—Vesicocervicovaginal (or Juxtacervical) Fistula.
The fistulous opening is near the cervix.

incision, with separation of the bladder from the cervix, as in the operation for juxtacervical fistula described above. If the communication between uterus

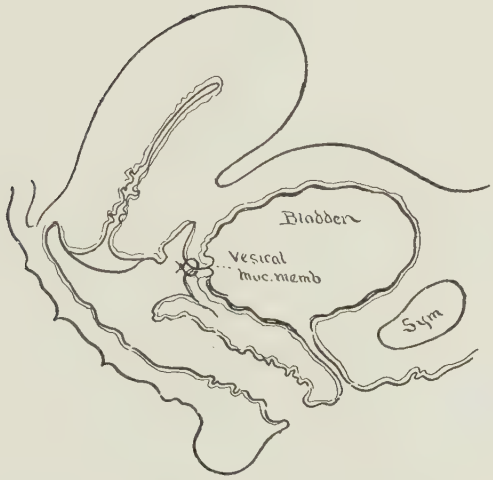


FIG. 353.—REPAIR OF JUXTACERVICAL FISTULA.

The bladder has been separated from the cervix. The bladder wall has been closed by a Lembert running stitch, which inverts the mucous membrane toward the lumen of the bladder. The vaginal membrane has not yet been sutured.

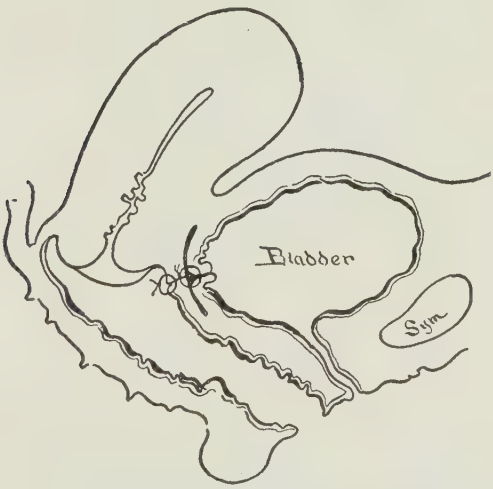


FIG. 354.—REPAIR OF JUXTACERVICAL FISTULA.

Both the bladder wall and the vaginal wall have been closed by separate layers of sutures.

and bladder is well up in the cervix the condition is best approached by the abdominal route, the details of the operation being as follows:

Median abdominal incision, with the patient in the Trendelenburg position. The uterus is held well back by traction forceps and a transverse incision made through the uterovesical reflection of peritoneum. The bladder is then separated from the cervix until the vesical opening is completely isolated with plenty of free bladder tissue about it to allow for suturing. The wound is closed by one or, if possible, two rows of Lembert sutures.

Fig. 355.—Juxtacervical Fistula. The Incision.

The opening into the uterine canal may be sutured or not. If the edges are freshened, it will heal spontaneously, and if not closed too tightly acts as a channel for drainage in case the bladder wound does not heal properly.

Vesico-uterine fistulæ may be closed indirectly by denuding and suturing the cervical lips (hysterostomatocleisis), by which procedure the uterus is made to drain into the bladder. The operation is not recommended unless other methods are not feasible.

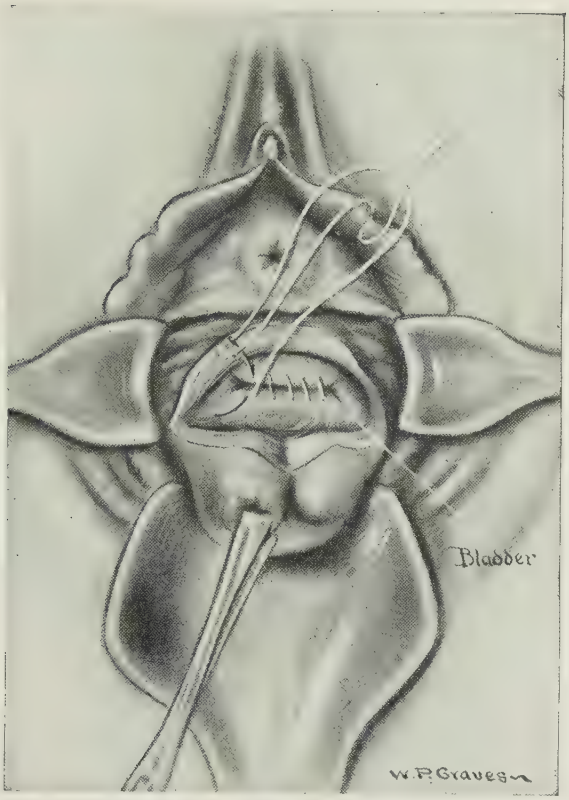


FIG. 356.—JUXTACERVICAL FISTULA.
The bladder has been freed from the cervix. The opening in the bladder is being closed in by a running Lembert suture.

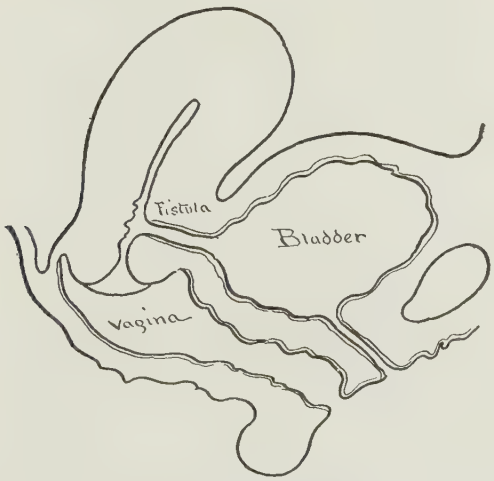


FIG. 357.—UTEROVESICAL FISTULA.
There is a fistulous communication between the bladder and the canal of the cervix.

FIG. 358.—REPAIR OF UTEROVESICAL FISTULA BY THE ABDOMINAL ROUTE.
An opening has been made through the peritoneal reflection, exposing the fistulous tract.

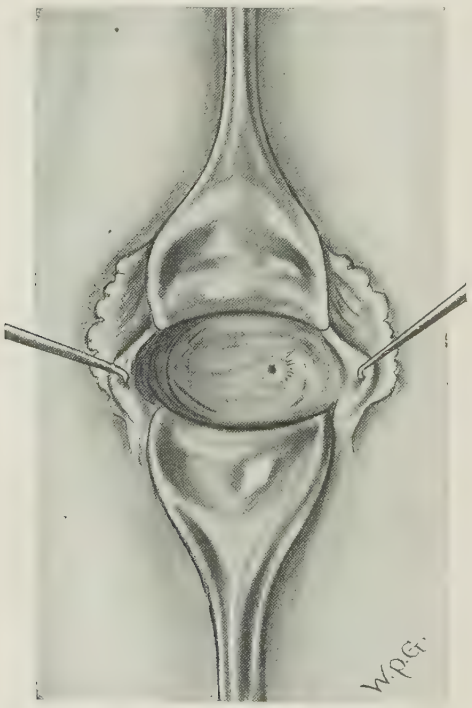


FIG. 359.—ACQUIRED ATRESIA OF THE VAGINA.
The later effect of simple incision without complete removal of the occluding membrane. The incision closes down to a pinhole opening which affords very incomplete drainage of the uterus and vagina. Foul decomposing material collects in the vagina and discharges continuously or periodically through the small opening in the membrane.

## OPERATIONS FOR ATRESIA OF THE VAGINA

The operation for atresia in girls, where there is partial or complete retention of menstrual blood, is attended with considerable danger of fatal sepsis, and every precaution should be taken to prevent infection. When hematocolpos and hematometra are present the occluding membrane is first freely incised, the cavities of the vagina and uterus evacuated and carefully irrigated. This does not complete the operation, for the opening made by such an incision sometimes closes up entirely, but more often results in one or more pinhole

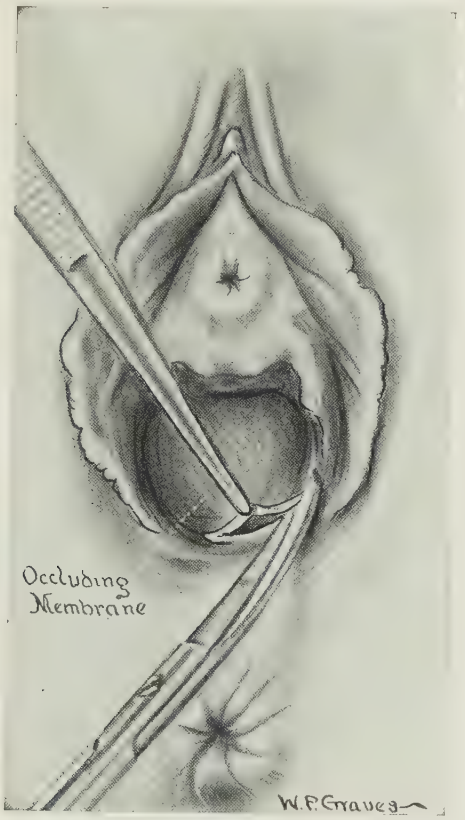


FIG. 360.—ACQUIRED ATRESIA OF THE VAGINA.
Dissecting out the occluding membrane with scissors.

apertures through which the menstrual blood may partially flow (Fig. 359). A certain amount of mucus and blood is dammed back into the vagina, becomes foully infected, and produces dire results. In order to leave the vagina in a permanently normal condition the occluding membrane should be completely dissected out and the wound edges approximated with great care. Such a wound will heal by first intention, even in the face of a badly septic discharge. The details of the operation for dissecting out an occluding membrane are as follows:

After the septum has been incised and the contents of the space beyond have been removed, there should be a thorough cleansing of the parts, as stated above. The edges of the septum should then be trimmed flush with the walls of the vagina (Fig. 360). All scar-tissue should be removed so as to prevent a future contraction. When the septum has been completely cleared away it will be found that there remains a denuded area which extends like a ring around the inner circumference of the vagina. The mucous membrane of the upper

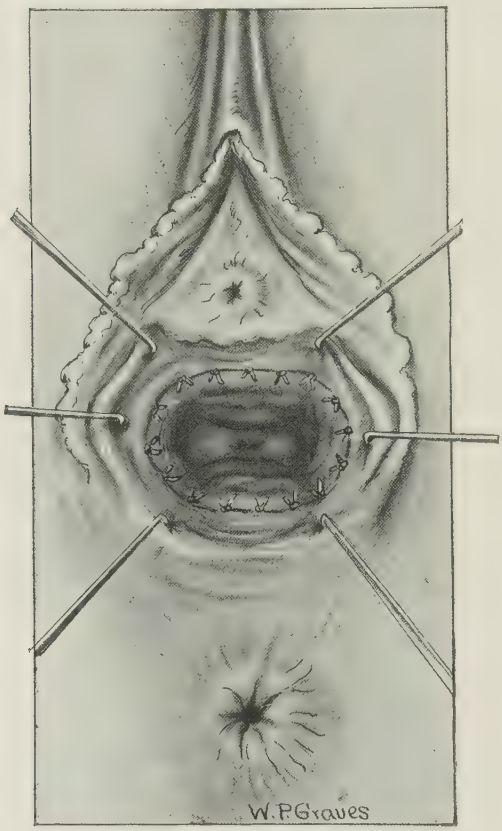


Fig. 361.—Acquired Atresia of the Vagina.
The transverse septum has been dissected out and the upper portion of the mucous membrane of the vagina united to the lower by interrupted catgut sutures.

portion of the vagina is then drawn down and approximated to that of the lower portion by interrupted catgut sutures (Fig. 361). Such an operation should restore perfectly the normal caliber of the vagina, and is not followed by a tendency to the development of a stricture. The use of antiseptic douches twice or three times daily is begun the day after the operation, and should be kept up until the discharge completely disappears.

## OPERATIONS FOR ABSENCE OF VAGINA

The creation of an artificial vagina may be done either by the method of employing a loop of gut or by the turning in of skin-flaps from the surrounding parts.

A technic devised and employed successfully by the author in one case is as follows:

The patient is placed in the perineal position. A superficial transverse incision is made just below the urethra. Through this transverse slit the bladder and rectum are slowly dissected apart with the finger. The forefinger of the left hand should be kept in the rectum, and some blunt instrument, like a

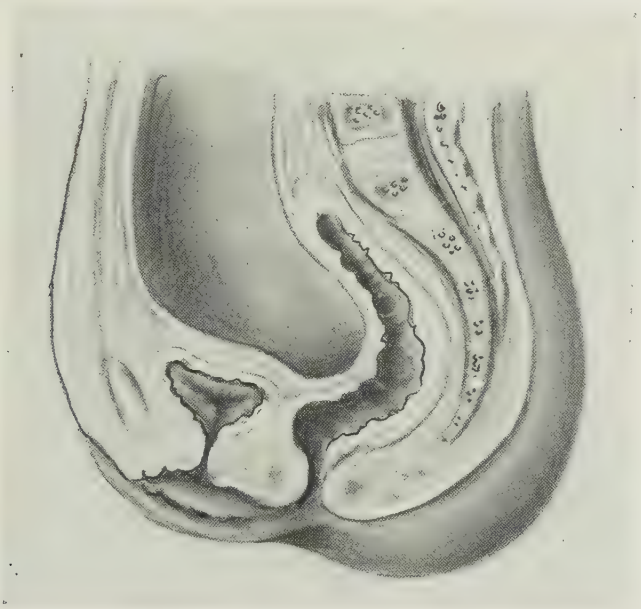

Fig. 362.—Congenital Absence of Vagina.

urethral dilator, should be held in the bladder by an assistant. The dissection is carried out by the right forefinger, the left forefinger behind and the blunt instrument in front acting as guides to prevent tearing into the wall of the rectum or bladder. In this way an artificial opening can be made of the exact proportions of the normal vagina. Care should be exercised not to enter the abdominal cavity. The next step is to line this cavity with a pouch of skin made up of flaps turned in from the surrounding parts. To accomplish this, the two labia minora are dissected off, from above downward, in such a manner as to leave a pedicle sufficiently large to furnish good circulation. The two surfaces are then split apart so that two paddle-shaped flaps remain. There should then be dissected from the inner side of the thigh two similar flaps which have their bases at the two lower corners of the artificial opening. All four flaps

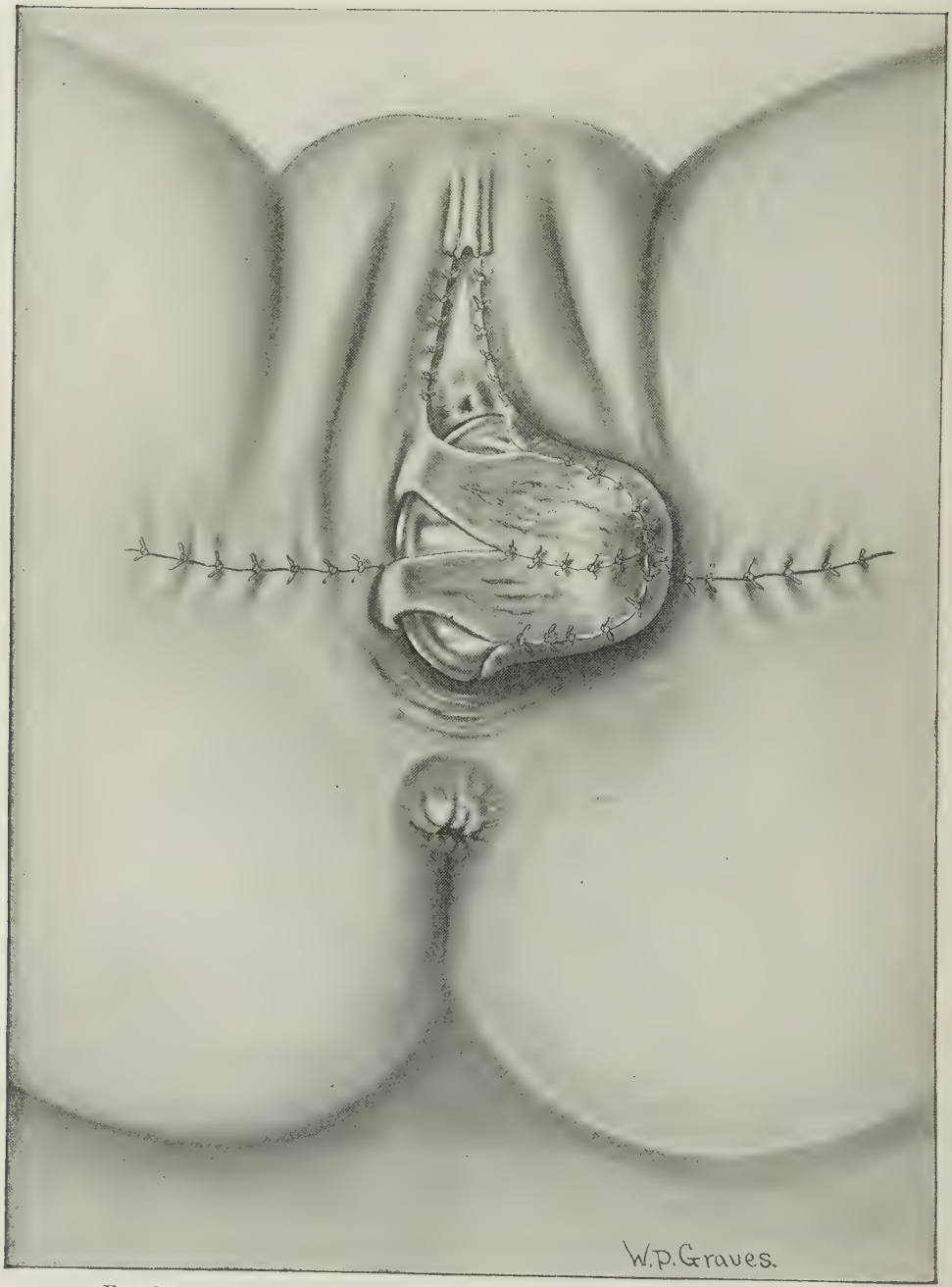


Fig. 363.—An Operation for Absence of the Vagina (Author's Method).

An artificial opening has been made between bladder and rectum, corresponding to the size of a normal vagina. Four skin-flaps have been sewed together over an old-fashioned glass speculum inverted. The two upper flaps are the two labia minora partially amputated and spread out flat. The two lower flaps are turned in from the thigh. The sewing of the seams is not completed until after the glass form has been removed and supporting stitches placed in the vault of the new vaginal opening.

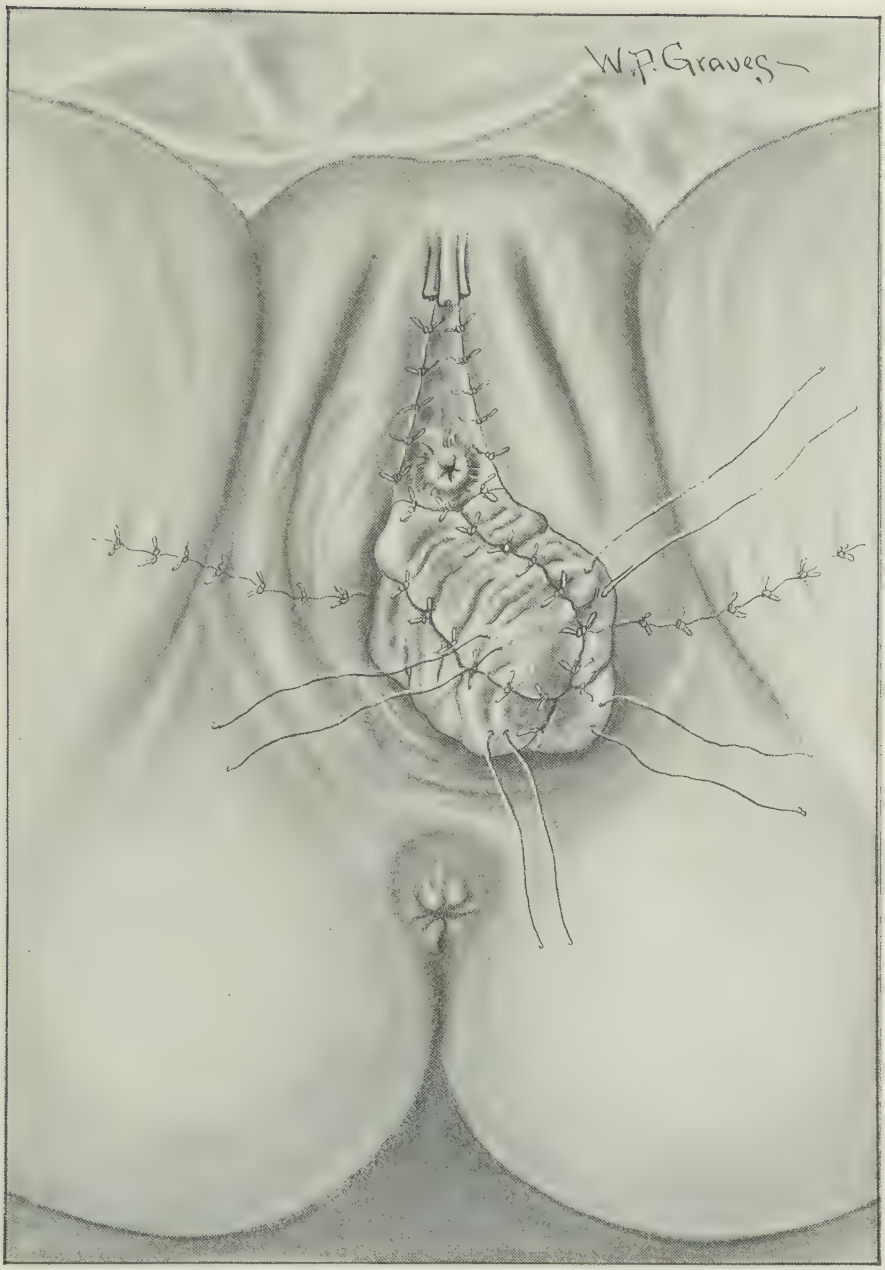


FIG. 364.—OPERATION FOR CONGENITAL ABSENCE OF VAGINA.

The glass form has been removed and the seams of the pouch completely sewed. The untied sutures seen issuing from the pouch were previously passed through the vault of the artificial opening made between the bladder and rectum. The pouch is inverted into the artificial opening and the stitches tied so as to prevent any prolapse of the pouch before it heals to the raw surface of the opening.

are then sewed together over a glass form, as shown in the cut (Fig. 363). Before the flaps are sewed together several catgut sutures, with the ends left long,

should be placed in the vault of the artificial cavity. When the skin pouch has been nearly completed, the glass form is removed and the catgut sutures are brought out through the skin pouch. The pouch is then inverted, and the sutures are tied in such a manner that the pouch fits snugly into the artificial cavity.

### Schubert's Operation for Absence of Vagina

Schubert has devised a method of creating an artificial vagina from the rectum. He performs his operation as follows:

The patient is placed in the right Sims position. The hymen is first completely dissected away, leaving a circular denuded area of tissue where the introitus is usually situated. The sphincter is then dilated and a circular incision made about the anus. Through this incision the rectum is dissected from the sphincter muscle for the distance of about 3 cm. without injuring the muscle.

Beginning then at a point 5 cm. above the anus a 10 cm. incision is made over the coccyx, which is extirpated. The pelvic fascia is divided by a longitudinal incision. Through this opening the rectum is drawn out after first being freed from its connective-tissue attachments. The rectum must be sufficiently freed so that the upper segment of the loop can be drawn down to the anus. The loop of rectum drawn out through the opening at the coccyx is now pinched with intestinal clamps and divided. The cut end of the lower segment is firmly closed by sutures. The culdesac of gut thus formed is attached as high as possible to the sacrospinal ligament.

The finger is then pushed through the opening in the vulva made by dissecting off the hymen, and an opening in the tissue made toward the coccygeal wound. The canal thus made is widened so that it will easily admit two fingers. The anal end of the rectum which was first dissected away from the sphincter is drawn up through the newly made orifice and attached there by interrupted sutures through the margin of the skin. The new vagina thus constructed, therefore, consists of the lower end of the rectum, which now extends from the new opening in the vulva to the blind culdesac attached to the sacrospinal ligament.

The operation is concluded by drawing the upper cut end of the rectum down through the sphincter and suturing it there to the skin margin.

The advantages of this operation over the Baldwin method are that it is less dangerous to life, and that the secretions from the bowel mucosa are less irritating.

### Baldwin's Operation for Absence of Vagina

*First Step.*—A transverse incision is made at the hymen (Fig. 365). The plane of cleavage between the rectum and bladder is sought, and the two organs separated by blunt dissection until the peritoneum is reached. A cavity is thus made corresponding in width and depth to a roomy vagina (Fig. 366).

An iodoform gauze tampon is inserted in this artificial opening and the patient put in the Trendelenburg position for laparotomy.

*Second Step.—Laparotomy.*—A median incision is made and the pelvis inspected. Rudimentary internal genitalia will be found, usually in the form of a double uterus. The two uteri should be separated by incision, and if one contains a lumen, it should be amputated. The junction of the ileum with the cecum is then sought. At the distance of about 12 inches from the cecum the

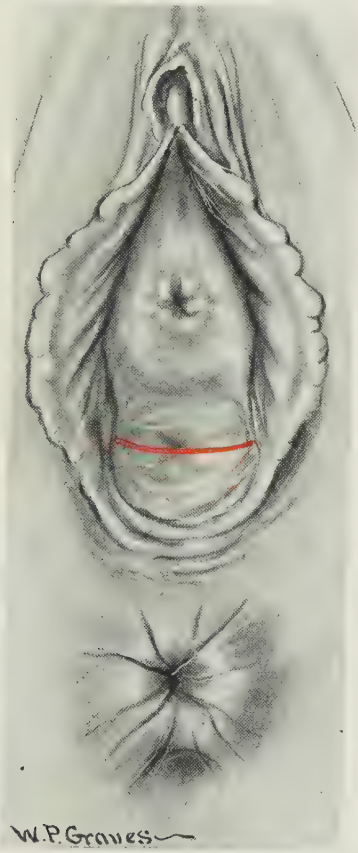


FIG. 365.—OPERATION FOR CONGENITAL ABSENCE OF THE VAGINA.
The red line shows the transverse incision made preliminary to separating the bladder from the rectum.

mesentery of the ileum is found to be especially long. Beginning at this point, about 10 inches of the ileum is resected and the ends of the resected portion closed by a purse-string suture. The two ends of the ileum are now united by a lateral anastomosis in front of the mesentery of the detached segment (Fig. 368). A silk ligature is passed around the detached portion of bowel at its middle point, to be used as a tractor (Fig. 368). An assistant removes the gauze tampon from the opening previously made between rectum and bladder and inserts a long clamp, which he pushes against the layer of peritoneum interven-

FIG. 366.—OPERATION FOR ARTIFICIAL VAGINA.
An opening has been made between the bladder and rectum as far as the peritoneum.

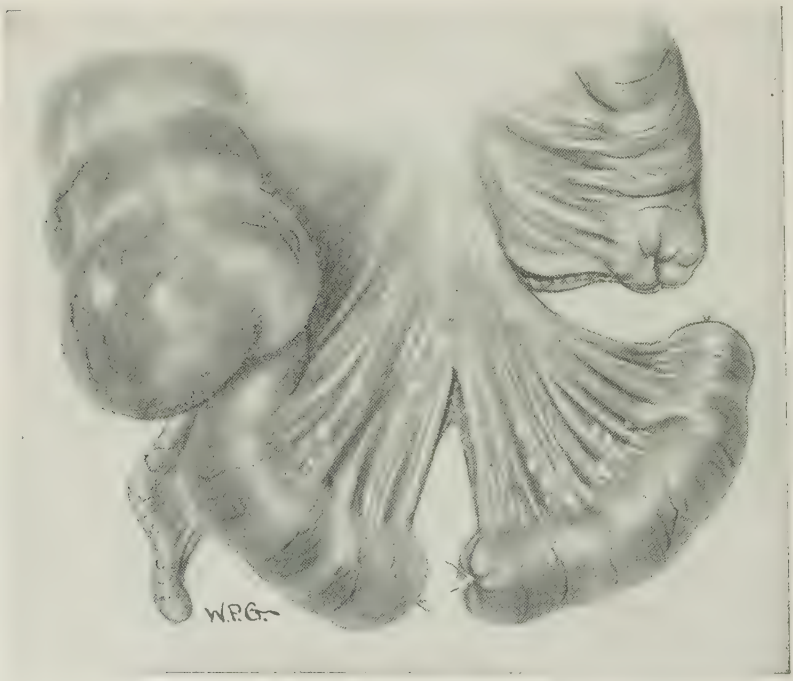


FIG. 367.—OPERATION FOR ARTIFICIAL VAGINA (BALDWIN'S METHOD).
A portion of the small intestine has been resected, leaving the mesentery attached.

ing between the opening and the peritoneal cavity. With this clamp as a guide an opening is made by the operator through the peritoneum, great care being exercised not to injure the bladder or rectum. The traction ligature is now grasped by the clamp, which by this means draws the detached segment of

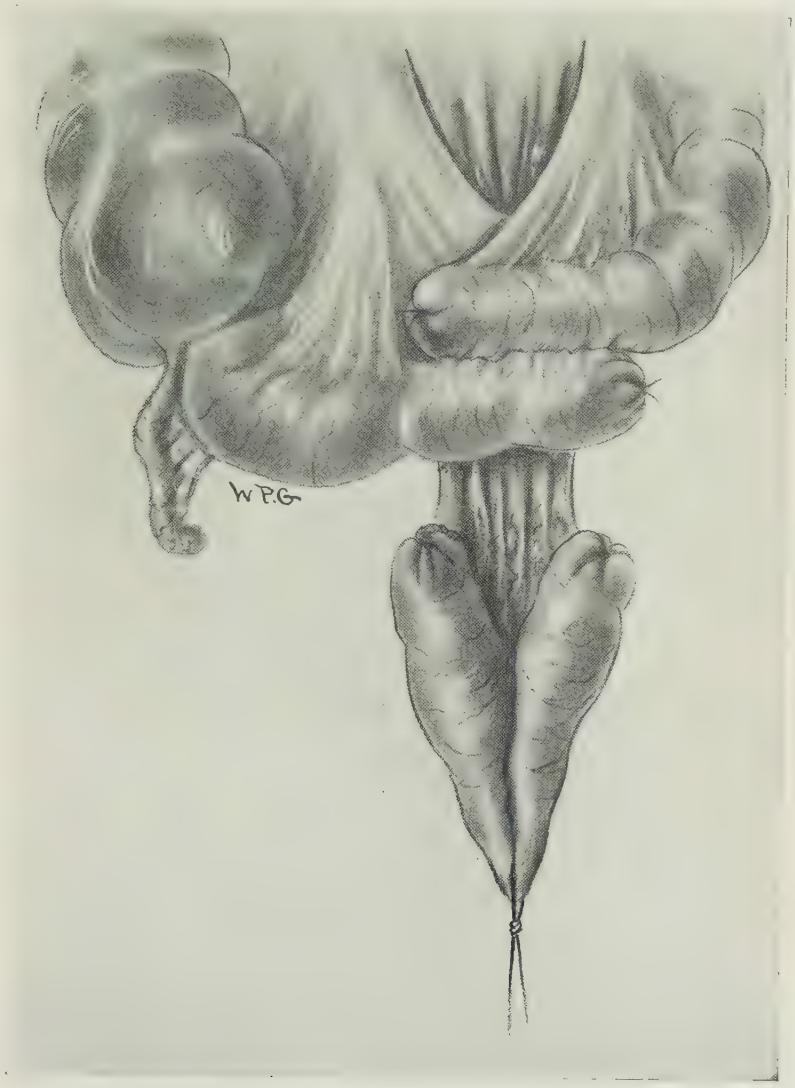


FIG. 368.—OPERATION FOR ARTIFICIAL VAGINA.
Lateral anastomosis uniting the ends of the resected gut. The free loop of intestine with mesentery attached is being drawn down by a guide ligature.

bowel down into the artificial opening in the form of a loop. The peritoneum is sewed with fine catgut sutures around the ends of the loop. The abdominal wound is closed.

*Third Step.*—The loop of bowel is drawn down until it extrudes from the new

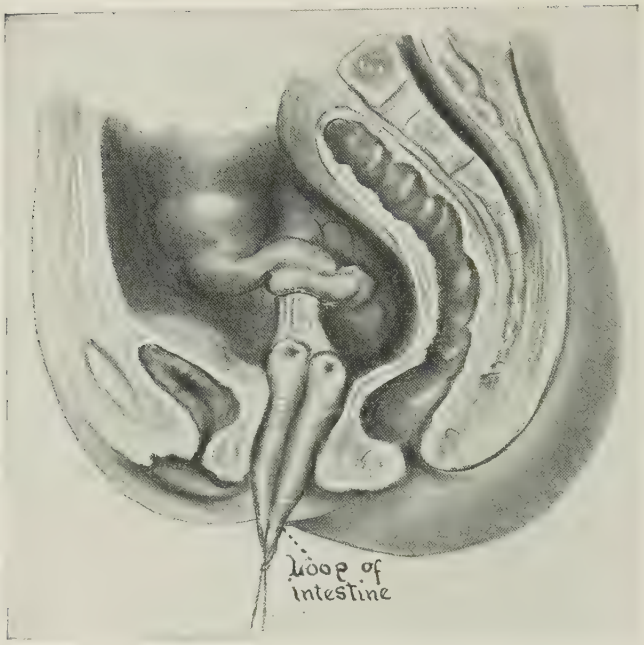


FIG. 369.—OPERATION FOR ARTIFICIAL VAGINA (BALDWIN'S METHOD).

A loop of intestine has been resected, leaving the mesentery attached. Lateral anastomosis has been performed, uniting the ends of the resected gut. The free loop of intestine has been drawn down through the opening made between bladder and rectum (after Stoeckel).

FIG. 370.—OPERATION FOR ARTIFICIAL VAGINA.

The free loop of intestine has been drawn down into the opening made between bladder and rectum. It has been stitched in place and an opening made in the wall. The septum made by the loop may be incised later.

introitus. The outer wall of the gut is incised and the edges stitched to the skin around the hymeneal opening. The two legs of the loop are twisted so that the left lies anterior and the right posterior. In this way a double vagina is formed (Fig. 369). The walls of the gut which form the septum between the two vaginal canals become adherent in the course of time. This septum may be incised later, so that a simple vagina is created. It should be remembered that the mucous membrane of the new vagina continues to secrete, and that it constitutes an absorbing surface, to which certain kinds of vaginal douches, like corrosive sublimate, may be a dangerous poison. The secretion is influenced by diet, being greatly increased by albuminous food.

## VAGINAL CELIOTOMY

### Anterior and Posterior Colpotomy

The vaginal route for the surgical treatment of such conditions as uterine fibroids, ovarian tumors, pelvic adhesions, extra-uterine pregnancy, etc., is now

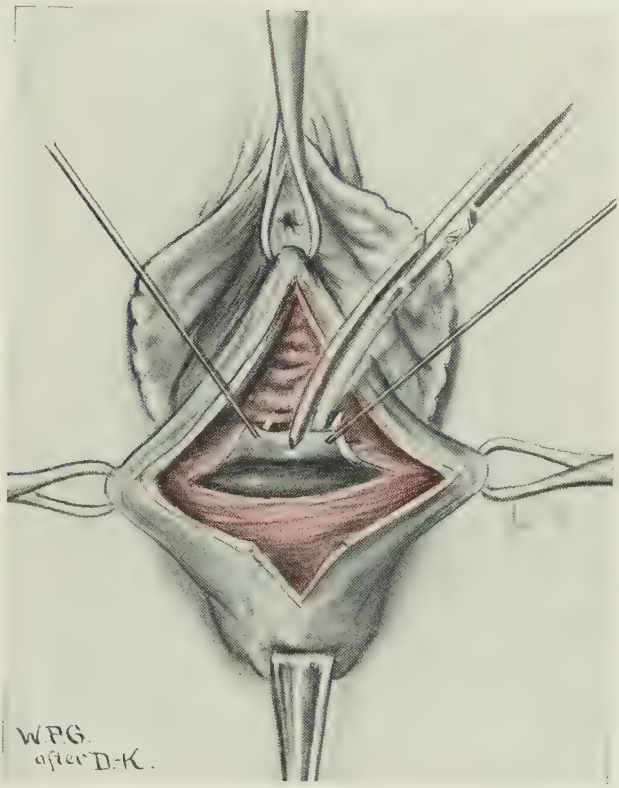


Fig. 371.—Anterior Colpotomy for Pelvic Operations by the Vaginal Route.

comparatively little used, and is for the most part confined to operations for prolapse, like those of Watkins and Goffe, and occasionally to vaginal hysterectomies.

The pelvis may be entered either by opening the anterior or posterior wall of the vagina.

*Anterior colpotomy* is performed in the following way: The anterior lip of the cervix is seized with traction forceps, and the uterus drawn strongly down toward the introitus. The peritoneal cavity may be entered either through a transverse incision made at the junction of the bladder and cervix or, preferably, by a ⊥-shaped opening. By the latter method an incision is made from a short distance below the urethra to the cervix. The vaginal wall on each side is then loosened from the bladder and a cross incision made at right

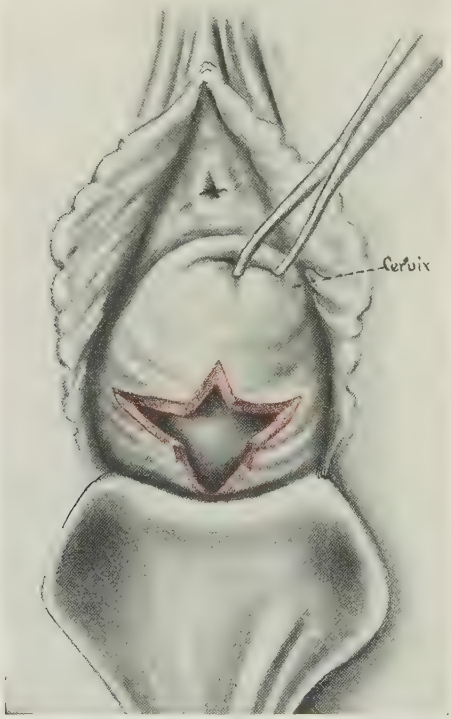


FIG. 372.—POSTERIOR COLPOTOMY.
Crucial incision through the posterior vaginal wall into the culdesac of Douglas.

angles to the first, at the level of the junction of the bladder with the cervix. The two flaps are further separated from the bladder wall by blunt dissection and drawn outward by traction hooks. The bladder is then stripped back from the cervix, care being taken not to injure its wall. When the peritoneal reflection is reached it is seized with tissue forceps and incised, the incision being carried to each side into the broad ligaments as far as possible. The peritoneum of the bladder reflection is lifted up and cut in the median line as far as the fundus of the bladder (Fig. 371). Into the opening thus made is inserted a speculum which draws the bladder up to the symphysis. The next step is the delivery of the uterus and adnexa through this opening. The traction

forceps on the anterior cervical lip is forced back toward the posterior wall of the vagina so as to antevert the uterus. The anterior wall of the uterus is seized with double hooks and the fundus drawn out of the wound. As the uterus is delivered, the tubes and ovaries come into view and slip out of the wound unless restrained by adhesions. The desired operation can then be performed.

*Posterior Colpotomy.*—The technic of posterior colpotomy is somewhat simpler than the anterior operation, but according to those who employ the vaginal route, notably Goffe, it is much less useful for the average case.

The posterior lip of the cervix is grasped with traction forceps and drawn forward toward the symphysis. The posterior vaginal wall is thus put on the stretch. A longitudinal incision about 5 cm. long is made, beginning at the portio and running back in the median line. The incision is carried through the vaginal wall, the loose cellular tissue, and into the peritoneal cavity. In order to enlarge the opening thus made, two lateral cuts may be made at right angles to the original incision (Fig. 372). To deliver the uterus and adnexa the posterior wall of the uterus is seized with double hooks and drawn backward out of the vaginal wound.

## OPERATIONS FOR UTERINE MALPOSITION

### Operations for Retroversion

#### Olshausen's Operation for Suspension of the Uterus (Author's Technic)

A short median suprapubic incision is made. The appendix is inspected and removed as a routine measure. The edges of the peritoneum and fascia on each side of the wound are clamped in order to facilitate the passage of stitches. Each round ligament is grasped near the uterus with a half-length clamp, which is pressed tightly enough to raise the ligament, but not to lacerate it. A liga-

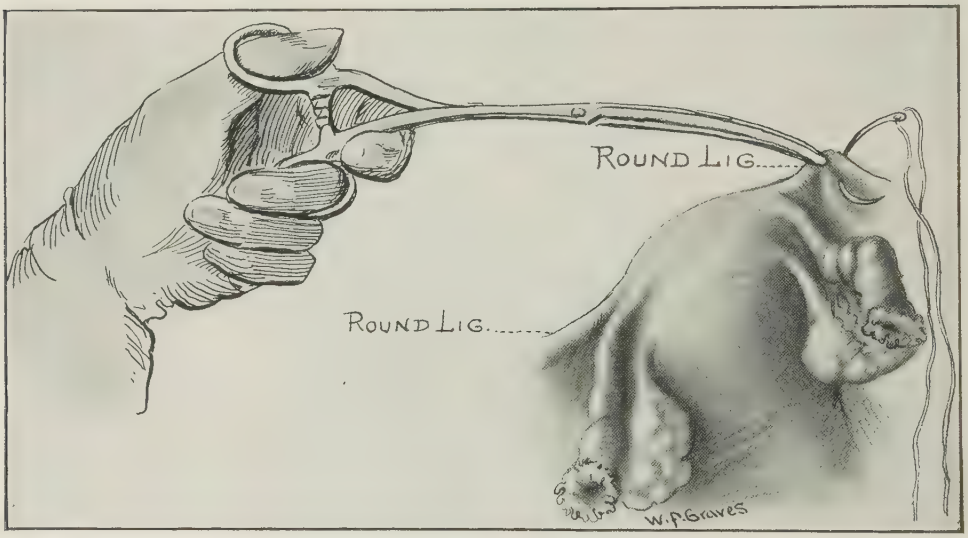


Fig. 373.—Olshausen's Operation. First Step.
The round ligament is lightly grasped with half-length forceps near the fundus. The silk suture is introduced so as to include the whole thickness of the ligament.

ture of No. 7 braided silk *doubled* is then passed under the right round ligament at a distance from the uterus which is determined by the size, weight, desire for mobility, etc., it being remembered that the nearer the uterus it is placed the greater will be the supporting power and the less the mobility. The average distance is $\frac{1}{2}$ inch. The suture is carried through the abdominal wall, including the peritoneum, muscle, and fascia, and then returned to the peritoneal cavity, including a bight in the wall of about $\frac{1}{4}$ to $\frac{1}{2}$ inch. The ligature is placed in the abdominal wall at a distance from the median line corresponding to the point where the base of the round ligament would touch the peritoneum if the uterus were brought up to the abdominal wall. The level at which it is

placed is also determined in the same way, except that if there is much prolapse or if it is desired to correct an anteflexion, the attachment is made some-

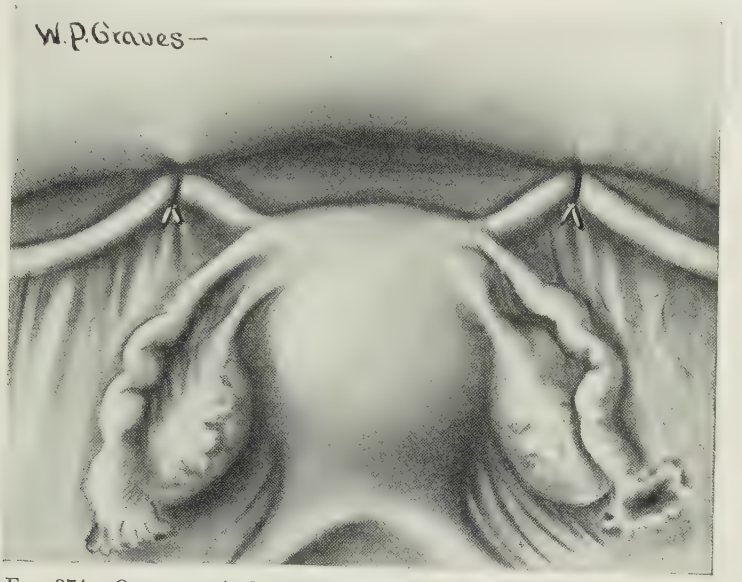


FIG. 374.—OLSHAUSEN'S OPERATION VIEWED FROM WITHIN THE ABDOMEN.
Tight ligature of the ligaments to the anterior abdominal wall creates two firm adhesions at the points of contact. The anatomic result is practically the same as that of Gilliam's operation.

what higher on the abdominal wall than would correspond to the natural position of approximation.

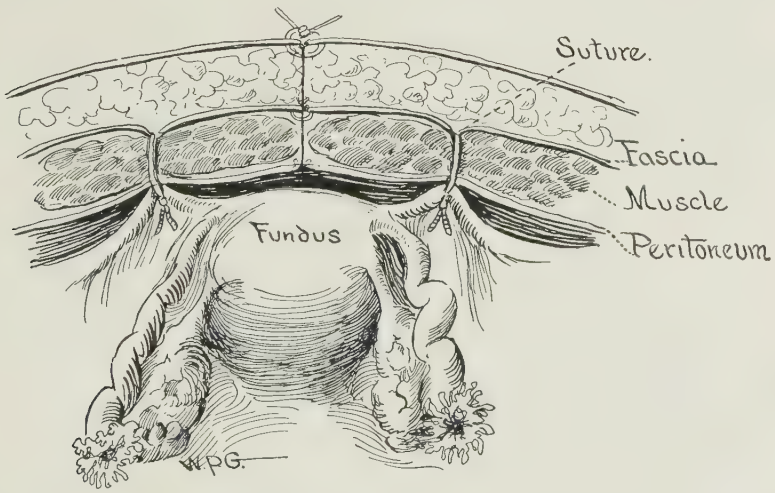


FIG. 375.—OLSHAUSEN'S OPERATION.
Showing the layers through which the supporting sutures are carried. Note that they include the peritoneum, muscle, and fascia, and are tied on the inside of the abdomen.

After placing the ligature on the right, the left one is introduced in the same way at a symmetric point on the other side of the wound. The ligatures are

then tied *within* the abdominal cavity. The success of the operation depends entirely on the tying of the ligatures, the object of which is to create two short, small, but powerful artificial ligamentous attachments between the abdominal wall and the round ligaments. In order to accomplish this it is necessary to injure mechanically the epithelium of the two contiguous peritoneal surfaces, and this is done by tying the ligatures as tightly as possible.

Silk is used because with no other form of ligature can so tight a knot be tied. It is used braided and doubled partly because it will not break in tying the knot and partly because it will not cut into the tissues when powerful tension is put upon it. It is somewhat undesirable to bury such a large permanent ligature in the abdominal wall, for if there is wound sepsis it may possibly become infected and cause a persistent sinus until it is removed. This does happen once in awhile, but the occurrence is so rare that it does not offset the advantages of the ligature.

It may be said in passing that a far more powerful and lasting ligament can be created between the round ligament and the abdominal than between the uterine wall and the abdominal wall. Fixation of the round ligaments is, therefore, more reliable than fixation of the uterus both for supporting strength and for the avoidance of immobilizing adhesions.

The Olshausen operation has the disadvantage of leaving two open spaces between the ligaments and the abdominal wall external to the stitches (Fig. 375).

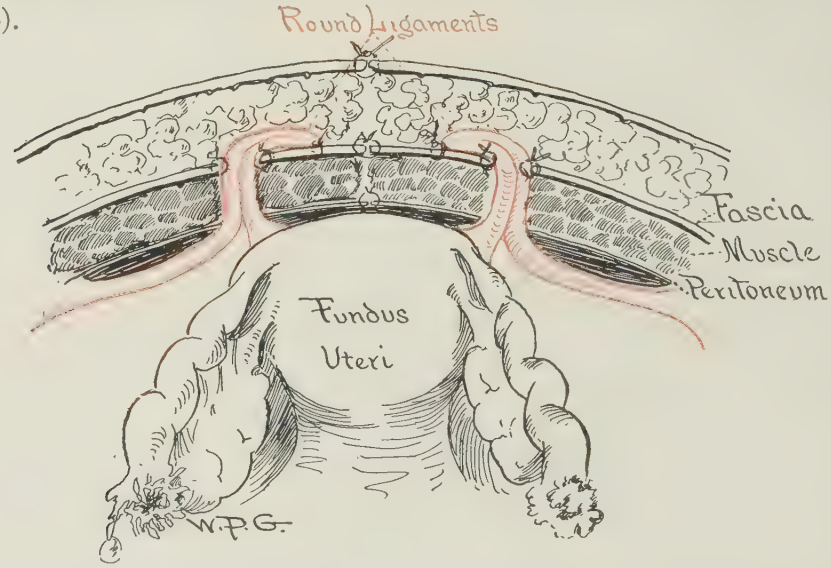


Fig. 376.—Gilliam's Operation.
The red lines indicate the course of the round ligaments, which are drawn up through all the layers and fastened on the outside of the fascia.

## VARIOUS FORMS OF THE GILLIAM OPERATION

**Gilliam's Operation.**—By the technic of the original Gilliam operation the perforating clamp is carried directly through the fascia, muscle, and peritoneum

into the peritoneal cavity without taking the oblique route through the internal ring. The round ligament is drawn directly out through the perforation and fastened to the *outer* side of the fascia (Fig. 376). This has the advantage over Simpson's operation of providing a direct rather than an indirect pull on the

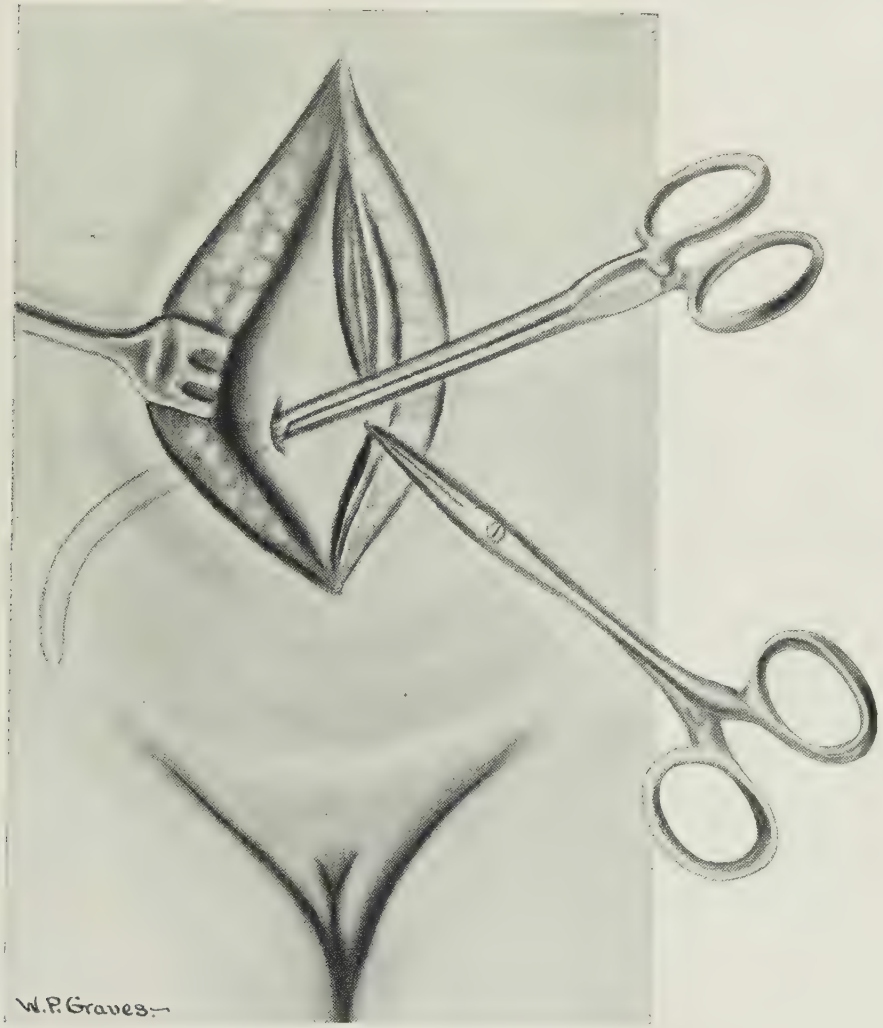


Fig. 377.—Simpson's Operation for Retroversion.

An opening has been made in the fascia and a specially curved clamp passed through it between fascia and muscle. The point of the curved clamp is about to enter the internal inguinal ring.

uterus, and, therefore, has greater supporting power. On the other hand, it leaves two openings on the sides through which the intestines may prolapse, and it also leaves two weak points in the fascia through which the loops are drawn.

**Simpson's Operation.**—Of the various modifications of the Gilliam round ligament operation, that of Simpson is, in the opinion of the author, the best.

This operation has the advantage of securing permanent anterior position of the uterus without danger of intestinal complications. It has excellent supporting power. There is, however, danger of adhesions forming between the uterus and the abdominal wall, causing an occluding diaphragm across the pelvis, with possible subjective symptoms and danger of dystocia. This latter danger which the operation shares with all the Gilliam operations, according to Simpson, is obviated if his technic be properly followed.

The technical steps of the operation are as follows: Through a median incision the round ligament is caught in pressure forceps about $1\frac{1}{2}$ inches from

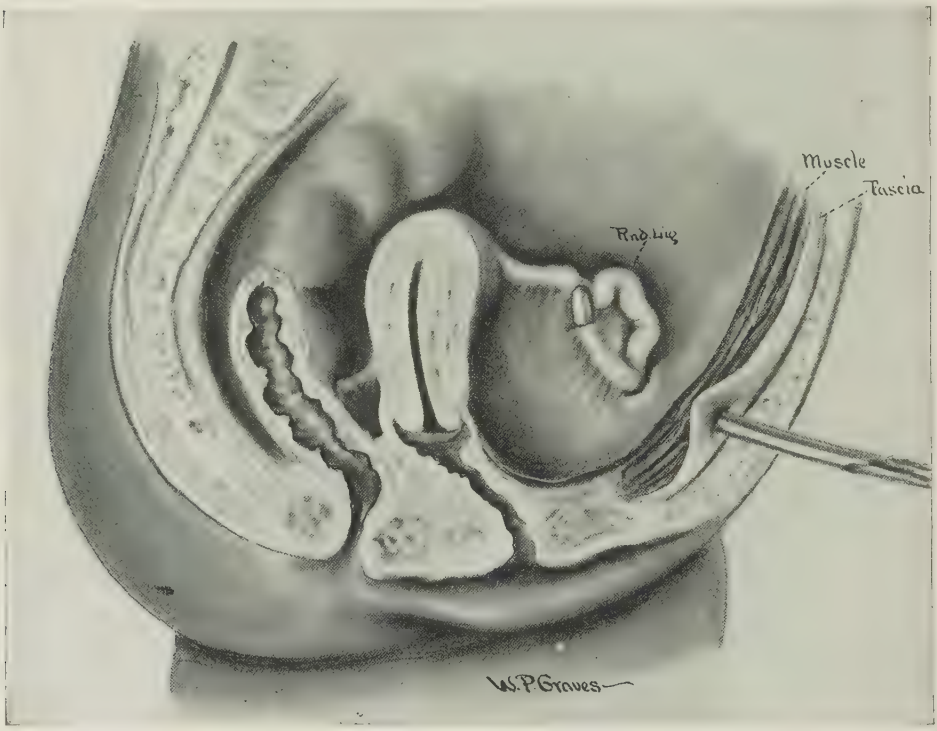


Fig. 378.—Simpson's Operation for Retroversion.

The curved clamp has been passed through the internal ring, beneath the peritoneum. It has pierced the peritoneum and is in the act of grasping the round ligament preparatory to drawing it back through the internal ring (adapted from Simpson).

the uterus. A second clamp grasps the parietal peritoneum at the point of the internal ring. The skin is retracted from the wound and the fascia punctured about $1\frac{1}{2}$ inches to the side of the lower angle of the incision. A specially curved clamp is passed through the puncture and obliquely through the rectus muscle, entering the space between the leaves of the broad ligament through the internal ring. It is forced along in the subperitoneal space until it reaches the clamp first placed on the round ligament $1\frac{1}{2}$ inches from the uterus. The curved clamp is forced through the peritoneum and made to grasp the round ligament. It is then drawn out, bringing the loop of round

ligament with it through the channel forced by its entrance into the abdominal cavity. The loop of the round ligament is fastened beneath the rent in the fascia by a linen thread, which closes the rent and attaches the ligament at the same time.

The procedure is repeated on the other side.

In choosing the point of the ligament which is to be drawn through the opening it is important not to take it too close to the uterus, for by this means the uterus is drawn too snugly against the anterior abdominal wall, causing the danger of occluding adhesions mentioned above.

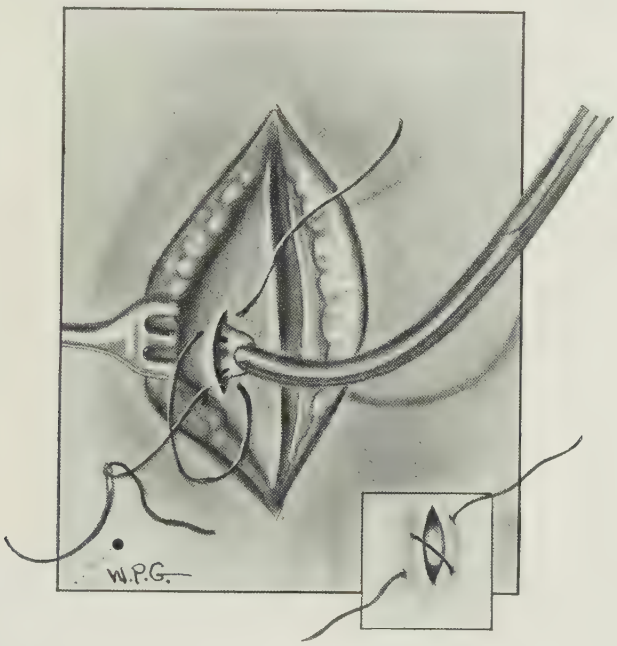


FIG. 379.—SIMPSON'S OPERATION FOR RETROVERSION.

The loop of round ligament is brought up to the opening in the fascia where it is being anchored by a figure-of-8 stitch. The insert shows how the stitch both fastens the ligament and closes the wound in the fascia.

In order to perform the Simpson operation easily it is of very great moment that the perforating clamp have a proper curve. The blades are somewhat longer and more fully curved than those of the ordinary half-length clamp. Without this curve the passage of the clamp into the abdominal cavity is sometimes extremely difficult.

**Mayo's Modification of Gilliam's Operation (Internal Alexander).**—In this operation the perforating clamp does not pierce the fascia, but passes between the fascia and the outer surface of the rectus. It then enters the internal ring and grasps the round ligament in exactly the same way as in the Simpson operation. After the ligaments are drawn out through the abdominal wall they are crossed over in front of the recti muscle and sewed together in the middle

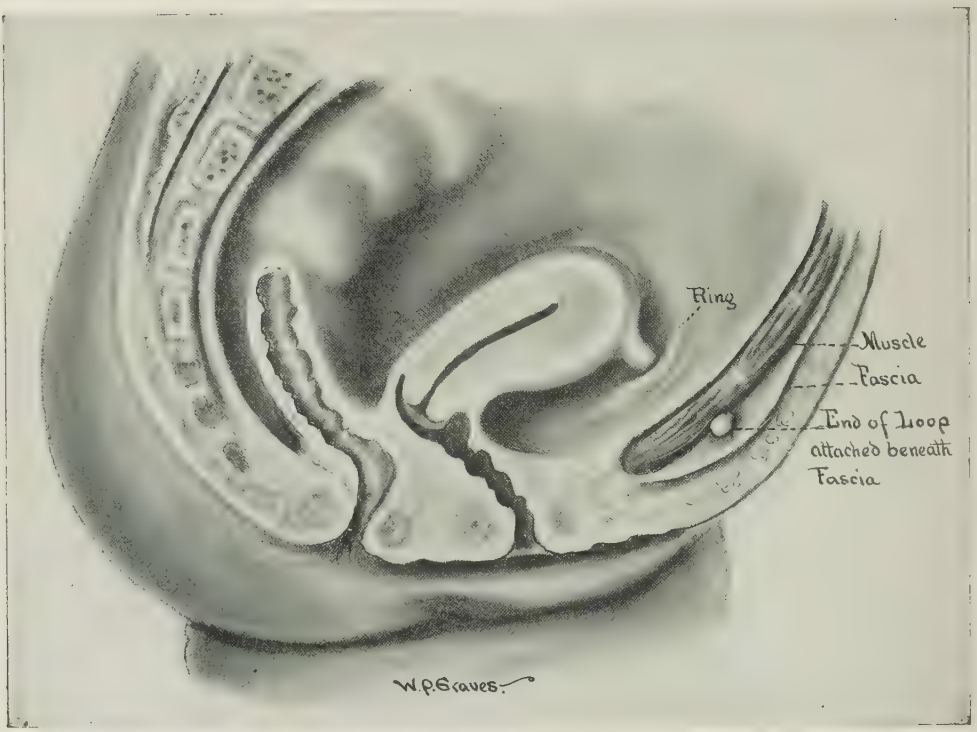


FIG. 380.—SIMPSON'S OPERATION FOR RETROVERSION.
The round ligament has been drawn through the internal ring and attached beneath the fascia (adapted from Simpson).

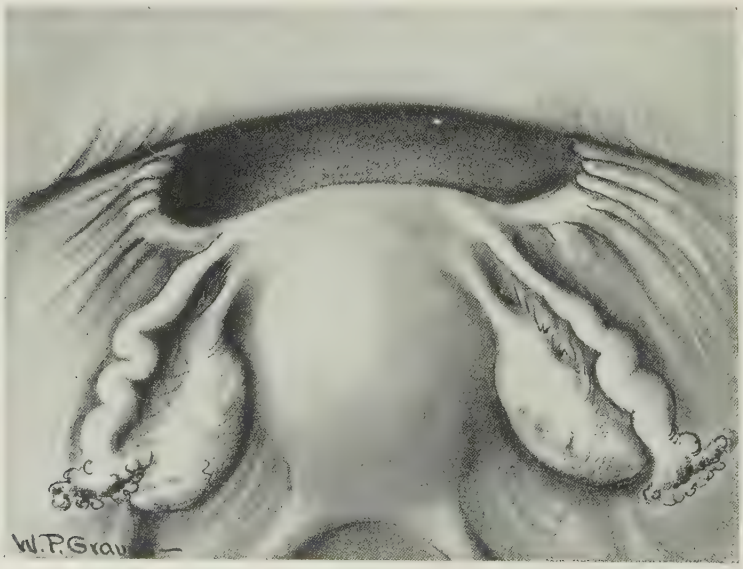


FIG. 381.—SIMPSON'S OPERATION FOR RETROVERSION.
The operation completed and viewed by imagination from inside the abdomen (adapted from Simpson).

line (Fig. 382). This operation has no advantages over the Simpson method, and involves the objectionable feature of joining the two loops, which incurs the danger of drawing the uterus up too tightly, with consequent adherence to the abdominal wall.

**Kelly's Modification of Gilliam's Operation.**—In this operation the perforating clamp passes directly through the rectus muscle and peritoneum, but not through the fascia, as in the original Gilliam's. The round ligament is

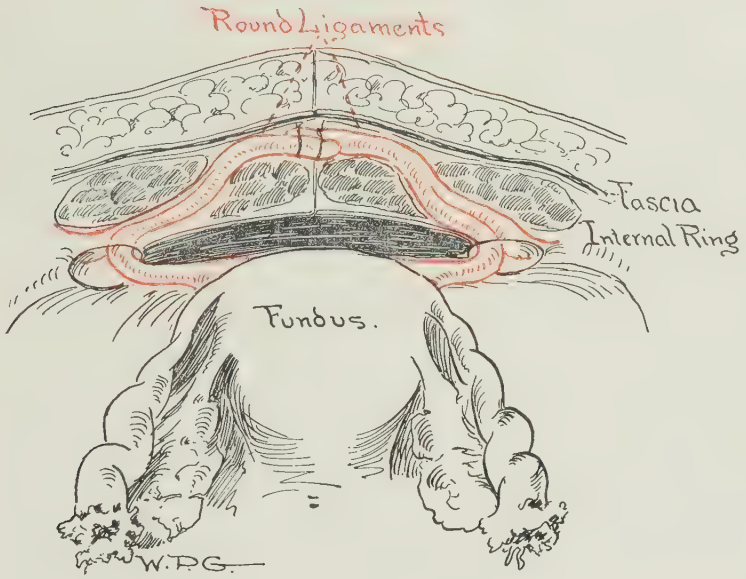


FIG. 382.—MAYO'S INTERNAL ALEXANDER.
The red lines indicate the course of the round ligaments. They are drawn through the inguinal rings over the muscle but underneath the fascia, the loops being united in the middle line.

drawn straight out, giving the same direct pull as in the Gilliam operation, and is joined across the rectus muscles with its fellow in the manner used by Mayo. The operation gives many excellent results, but has the same objections as Mayo's operation.

### BALDY'S OPERATION (Also Called the Baldy-Webster Operation)

This operation is useful for cases of simple retroversion and for retroversion with moderate prolapse, where no great supporting power is required. It has the advantage of securing a position of the uterus more nearly normal than does any other operation. It is also devoid of danger from childbirth or from complications of intestinal obstruction.

The operation is performed in the Trendelenburg position. The broad ligament of the right side is pierced by a half-length clamp at a point close to the uterus and directly under the ovarian ligament. The round ligament is then grasped by thumb forceps at a point about one-third of the length of the ligament

from the uterine end. The ligament is carried by means of thumb forceps into the bite of the perforating clamp, which thus seizes the ligament and draws it through the perforated opening to the posterior wall of the uterus. The round ligament of the left side is then drawn through an opening in the left broad ligament in exactly the same manner. The loops of the two round ligaments are next sutured together, several stitches being also placed to unite them to the posterior wall of the uterus. Care must be taken to attach the ligaments at

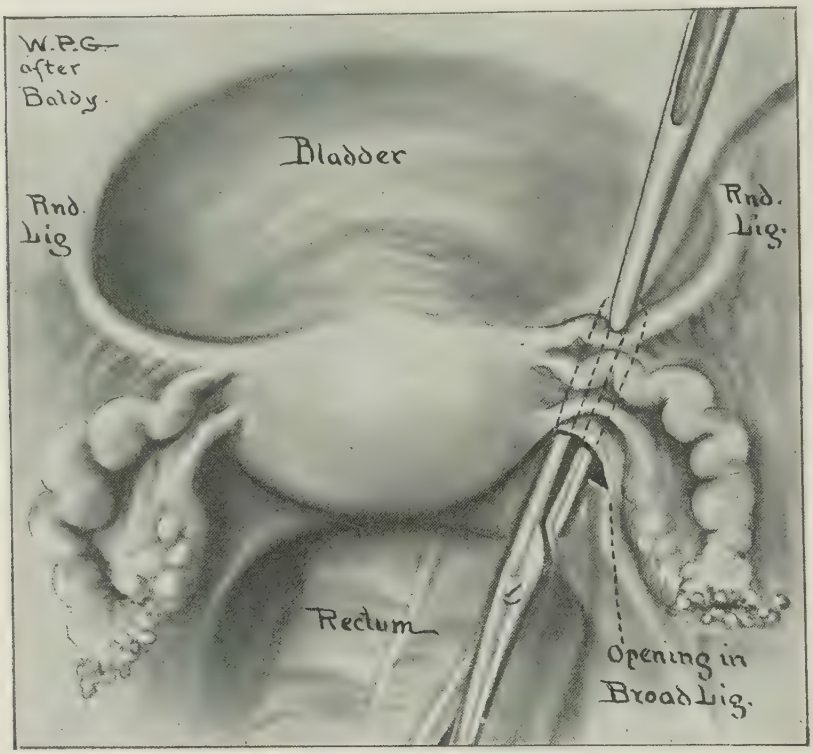


Fig. 383.—Baldy-Webster Operation for Retroversion.

An opening is made through the broad ligament just under the suspensory ligament of the ovary. A half-length forceps passed through the opening grasps the round ligament and draws it backward.

just the right level on the back of the uterus, for if the attachment is too low the uterus may become retroflexed over the ligaments, and if the attachment is made too high there is danger of causing an anteflexion of the uterus. The perforation of the broad ligaments and the suture of the round ligaments must be done with as little damage to the peritoneum as possible, for otherwise there is liability of adhesions of the ovaries, a complication for which the operation has been criticized.

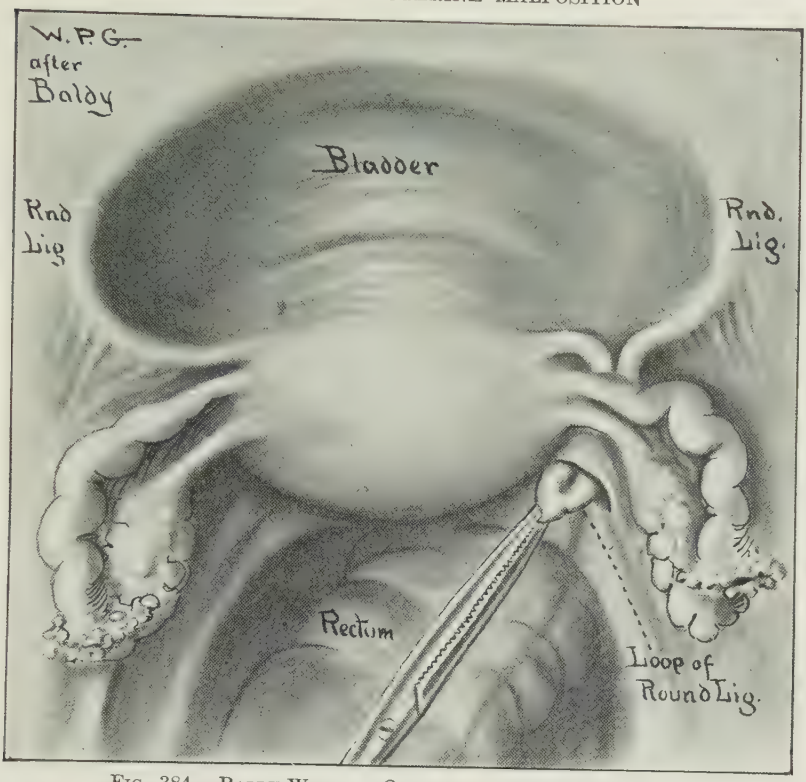


FIG. 384.—BALDY-WEBSTER OPERATION FOR RETROVERSION.
The round ligament of the right side is being drawn through the opening in the broad ligament.

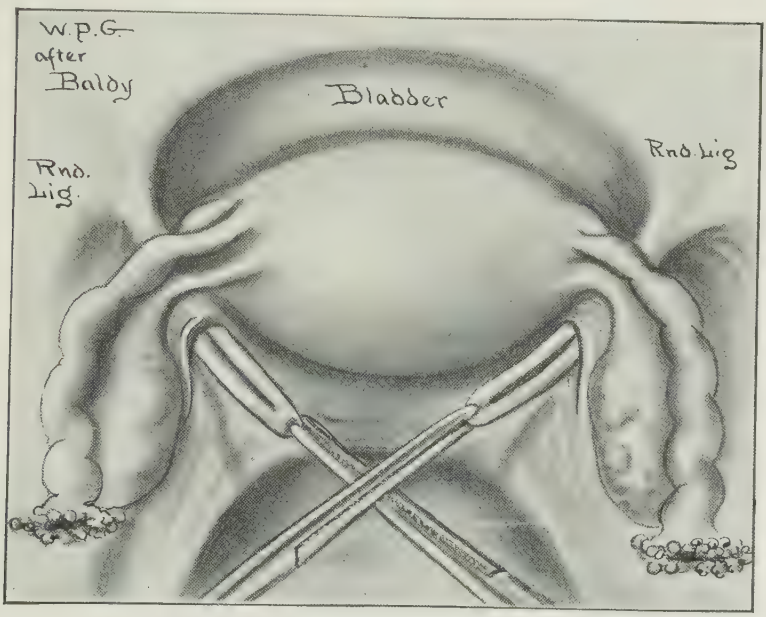


FIG. 385.—BALDY-WEBSTER OPERATION FOR RETROVERSION.
The round ligaments of the two sides are being drawn backward through the openings in the broad ligaments.

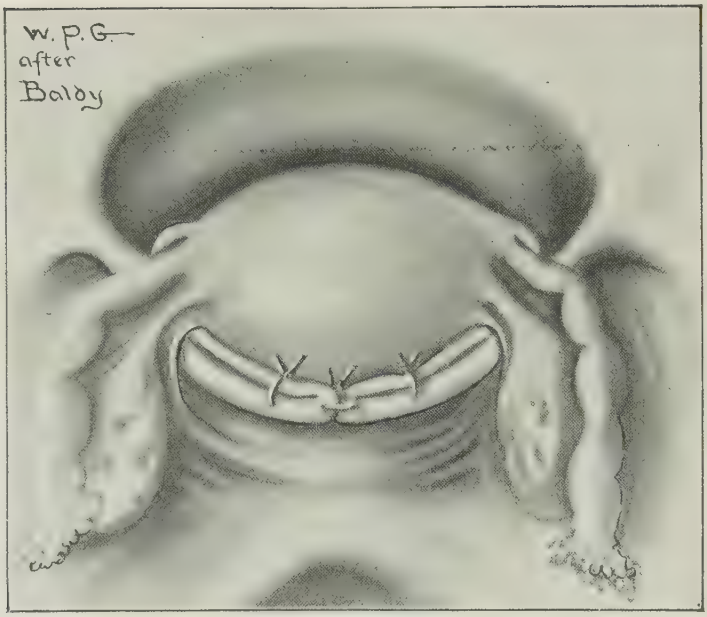


Fig. 386.—Baldy-Webster Operation for Retroversion.
The two round ligaments are attached together and to the posterior wall of the uterus.

## ALEXANDER'S OPERATION

As originally performed the Alexander operation was based on the principle of restoring the retroverted uterus to a forward position by drawing the round ligaments through the inguinal rings, where they were anchored by sutures, the slack of the ligaments being either cut or reduplicated. In the earlier days it had the great advantage of avoiding the necessity of opening the abdominal cavity, which at that time constituted a dangerous major operation. There were, however, serious drawbacks to the success of the operation, so that when asepsis and improved surgery made exposure of the peritoneum comparatively safe, it was generally discarded in favor of the newer procedures for replacing the uterus. Among the disadvantages attending the operation may be mentioned, first, the frequent difficulty of finding the ligament. It was usually sought for at the external ring, where its muscular elements blend in connective-tissue fibers running down into the labium majus. If it could not be found here, it was sought in the inguinal canal, where it is often vague and difficult to distinguish from the surrounding parts. Not infrequently wounds were closed without either ligament being discovered. Another difficulty was the frequency with which the ligaments broke when tension was exerted on them. Still another disadvantage was the inability to determine whether or not the retroverted uterus was adherent, in which case the operation was valueless. Inguinal hernias and wound sepsis were common complications. In the study of a series of Alexander operations performed in the old way the author found 15 per cent. of recurrences in cases personally examined.

Though the operation is little used at the present day in this country, it has been revived abroad under the name of the Alexander-Adams operation, but with an improved technic which does away with many of the former objectionable features. By the newer method the peritoneal cavity is opened at the inguinal ring, so that if the ligament has not been found in the inguinal canal it can be traced from within the abdomen outward. By securing the ligaments within the abdomen they may be drawn out without danger of rupturing them. Moreover, the opening of the abdomen enables the surgeon to palpate the uterus, determine its position after traction of the ligaments, ascertain the presence or absence of adhesions, and perform minor operations on the appendages.

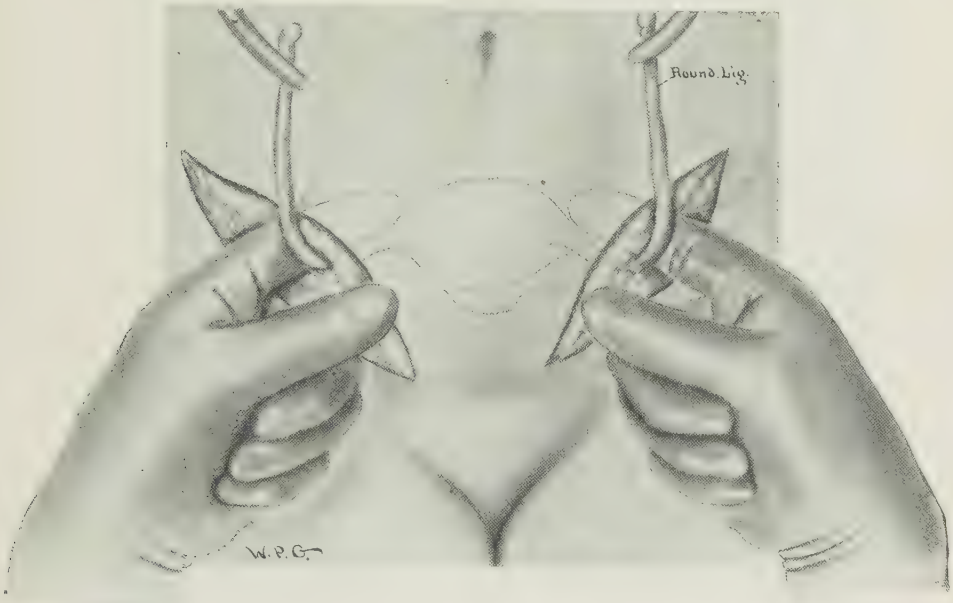


FIG. 387.—ALEXANDER-ADAMS OPERATION FOR RETROVERSION.

The round ligaments have been cut and freed, and are being drawn upward by traction clamps. The peritoneum has been opened on both sides. The position and condition of the uterus is being explored by the two forefingers.

In closing the wound the danger of postoperative hernia is lessened by treating the canal in the manner of a Bassini operation for inguinal hernia—*i. e.*, sewing the conjoined tendon to Poupart's ligament.

The technic of the operation, as used abroad and described by Döderlein-Krönig, is as follows:

A 3-inch incision is made parallel to Poupart's ligament as in the operation for inguinal hernia. The incision through skin, fat, and superficial fascia is carried down to the white glistening fascia of the external oblique muscle. The external inguinal ring is exposed, easily recognizable by the divergence of the fascial fibers and by its relation to the pubic spine. The fibers of the external

oblique are split above the external ring in a direction parallel with Poupart's ligament. In ordinary cases the round ligament may easily be seen lying in the bed of the inguinal canal, but if it cannot be distinctly defined, an opening is made through the peritoneum at the internal ring, when the ligament can be followed from within outward. The ligament is drawn up with two clamps at its distal end and severed between the clamps. It is then freed from its bed and drawn firmly outward until the cone-shaped reflection of the peritoneum surrounding the proximal end of the ligament is brought into view.

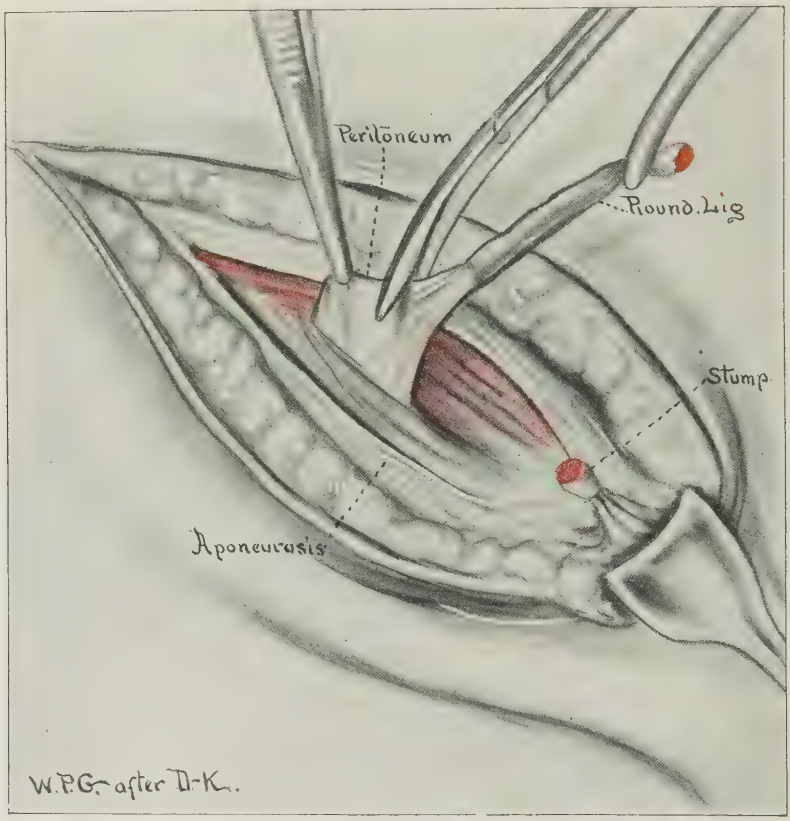


Fig. 388.—Alexander-Adams Operation for Retroversion.
Opening the peritoneum. By traction on the round ligament the peritoneum is drawn up in a funnel-shaped fold (after Döderlein-Krönig).

The peritoneal reflection is now opened (Fig. 388), and the operation up to this point repeated on the other side.

The forefingers of the two hands are now introduced into the peritoneal cavity, as in Fig. 387, and the pelvis explored. By this maneuver the position of the uterus is controlled. When the desired position is attained the ligaments are sewed to the under side of the outer flap of fascia and the redundant portion cut off. In order to guard against possible postoperative hernia the edge of the

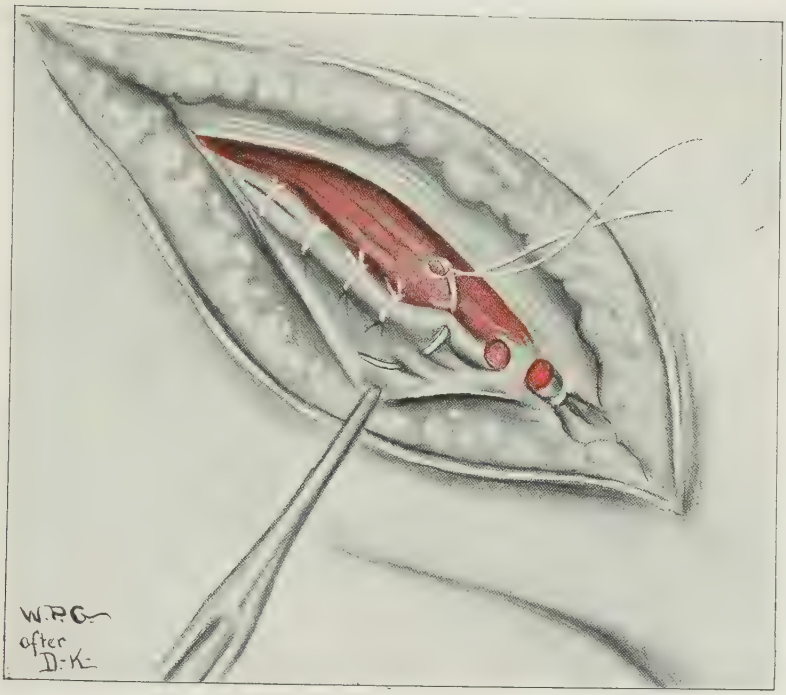


FIG. 389.—ALEXANDER-ADAMS OPERATION FOR RETROVERSION.
Closure of peritoneal opening and suture of the round ligament to the under side of the fascia (after Döderlein-Krönig).

conjoined tendon is attached by a few stitches to Poupart's ligament. The wound is closed by overlapping the fascia layer.

## OPERATIONS FOR ANTEFLEXION

### PESSARIES FOR ANTEFLEXION OF THE CERVIX

As has been stated (see page 500), the use of intra-uterine pessaries is unsurgical in principle, and may be followed by inflammatory processes in the tubes, of which we have observed two instances. Nevertheless, even with this risk the procedure is regarded as justifiable and is very widely employed. If applied to the proper cases the results gained by pessaries, both for dysmenorrhea and sterility, are comparatively good.

Numerous forms of pessaries are in use, some of which require sutures in the cervix to keep them in place, others being self-retaining in principle. We greatly prefer the latter type, as the sutures used for sewing in the instrument inevitably cause a greater or less inflammatory reaction in the cervix that sometimes continues in the form of a chronic cervicitis or endocervicits after the removal of the pessary.

In using the other type of intra-uterine pessary it is important to insert also a vaginal pessary, which not only prevents the intra-uterine instrument

FIG. 390.—UTERINE STEM-PESSARY CONTAINING GROOVE FOR DRAINAGE.

FIG. 391.—CHAMBERLAIN'S INTRA-UTERINE STEM-PESSARY.

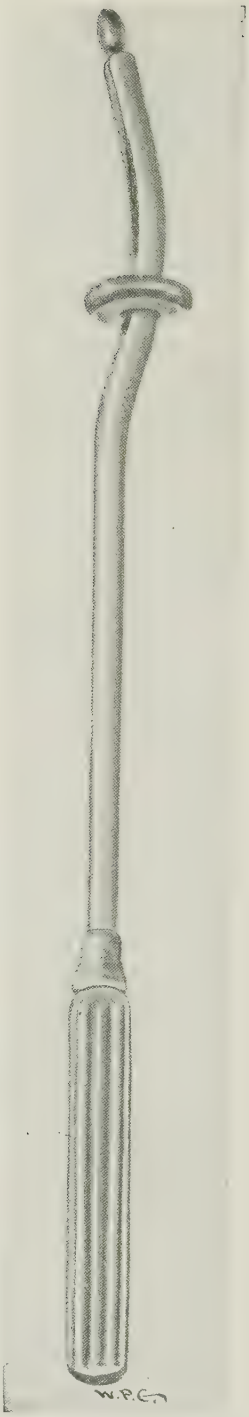

FIG. 392.—APPLICATOR USED FOR INTRODUCING THE UTERINE STEM-PESSARY PICTURED IN FIG. 391.

from slipping out, but also maintains a good position of the uterus, which in most cases of anteflexion is retrocessed.

The forms of pessary recommended by the author are shown in Figs. 390 and 391. In the first one there is a groove that provides for proper drainage. The second pessary shown is an excellent one, ingeniously devised by Chamberlain. It is conveniently introduced by the applicator shown in Fig. 392.

In applying an intra-uterine pessary the patient should be under complete anesthesia in order that the cervix may be thoroughly dilated. It is usually not necessary to curet the endometrium. In fact, it is desirable to leave this intact, for the dangers of sepsis are increased if a foreign body in the form of a pessary is left in contact with an abraded mucous surface.

The pessary is left in from six weeks to two or three months. It must be very carefully watched by the attending physician, and should be removed at once if undue leukorrheal discharge or pelvic pain appear. The self-retaining pessaries can be extracted without trouble. Those, however, that have been sewed into the cervix sometimes cause considerable embarrassment in their removal.

## OPERATIONS ON THE CERVIX FOR ANTEFLEXION

Several operations on the cervix for straightening the uterine canal have been devised. *Baker's operation* consists in removing a transverse wedge from the posterior wall of the cervix. The operation is a difficult one, and can best be performed with the patient in the Sims position. An oval incision is made, the width of which includes most of the posterior vaginal portion of the cervix, the ends of the oval being carried around to the sides of the cervix. In excising the wedge it is usually necessary to enter the cervical canal, which, however, does no harm. Severe bleeding may be encountered as the wound reaches to the sides of the cervix. The bleeding vessels should be tied with ligatures sewed into the cervical tissue. The wound is closed with interrupted catgut stitches. This operation, if properly done, straightens out the angulation of the cervix and does not mutilate it. Symptomatic results are, however, only moderately satisfactory.

*Pozzi's operation* consists in creating an artificial bilateral laceration of the cervix.

With the patient in the perineal position, the anterior and posterior lips of the cervix are incised deeply to the level of the internal os, in the form of a bilateral laceration. Wedge-shaped pieces of cervical tissue are removed from the two wounds thus made in order to allow for the approximation of the vaginal and cervical mucous membranes. The wounds are closed with interrupted catgut sutures. This operation is a mutilating one, and is apt to be followed by the same complications that result from laceration by childbirth—*i. e.*, ectropion, endocervicitis, and cervicitis. Our short experience with the operation has been unsatisfactory, and we have discarded it in our clinic.

**Dudley's Operation.**—Another principle, used for many years for anteflexion, is that of posterior discission of the cervix, including the internal os. This does away with the lower leg of the angle and theoretically relieves obstruction. The technic devised by Dudley is the best one to employ in performing this operation.

With the patient either in the Sims or perineal position, the cervix is first thoroughly dilated. The posterior wall of the cervix is then divided exactly in the median line back as far as the junction of cervix and vagina.

The next step is to sever the constriction at the internal os. This is done with a narrow scalpel, which, under guidance of the finger, cuts the fibers of the internal os until the opening is sufficiently wide to admit the finger into the

FIG. 393.—DUDLEY'S OPERATION FOR ANTEFLEXION.
Removal of wedges from the sides of the incision and placing of the approximating stitch.

FIG. 394.—DUDLEY'S OPERATION FOR ANTEFLEXION.
Closure of the wound.

uterine canal. Care must be exercised in performing this part of the operation not to enter the peritoneal cavity in the pouch of Douglas, an accident that, however, does no special harm.

The next maneuver is to approximate the ends of the wound at the external os to the upper angle of the wound. In order to accomplish this without tension, wedge-shaped pieces of tissue are removed from the middle portion of each side of the wound, as shown in the drawing (Fig. 393). A stitch is then introduced in the manner shown in Fig. 393, which when taut draws the posterior part of the external os up to the angle of the wound at the internal os. Stitches are placed in the lateral parts of the wound to control hemorrhage and secure good coaptation of the wound edges.

This operation is frequently followed by good results as regards the relief of dysmenorrhea and the cure of sterility. It is, however, mutilating to the cervix, and is often followed by ectropion and endocervicitis with annoying leukorrheal discharge. We have on a number of occasions been obliged to perform a tracheloplasty to relieve the symptoms caused by the operation.

### ABDOMINAL OPERATION FOR ANTEFLEXION (AUTHOR'S METHOD)

As has been pointed out on page 516, the only way permanently to straighten out an anteflexed uterus without mutilating it is by means of suspending it

FIG. 395.—POSITION OF UTERUS IN ANTEFLEXION.
The uterus is sharply bent on itself and the whole organ sags back toward the sacrum in the position of retrocession. The cervix is disproportionately long.

from above. We have employed this principle for several years, and have secured much better results, especially for dysmenorrhea, than by any other method.

The mechanical principle involved is illustrated in Figs. 395 and 396, in which it is seen that the anteflexed retrocessed uterus may be brought into a practically normal position by suspension from the abdominal wall.

Several operations may be used for the reduction of anteflexion—*e. g.*, the

Alexander-Adams, Gilliam's, Mayo's, Simpson's, and Olshausen's. The Baldy-Webster and Coffey operations are inapplicable to this condition.

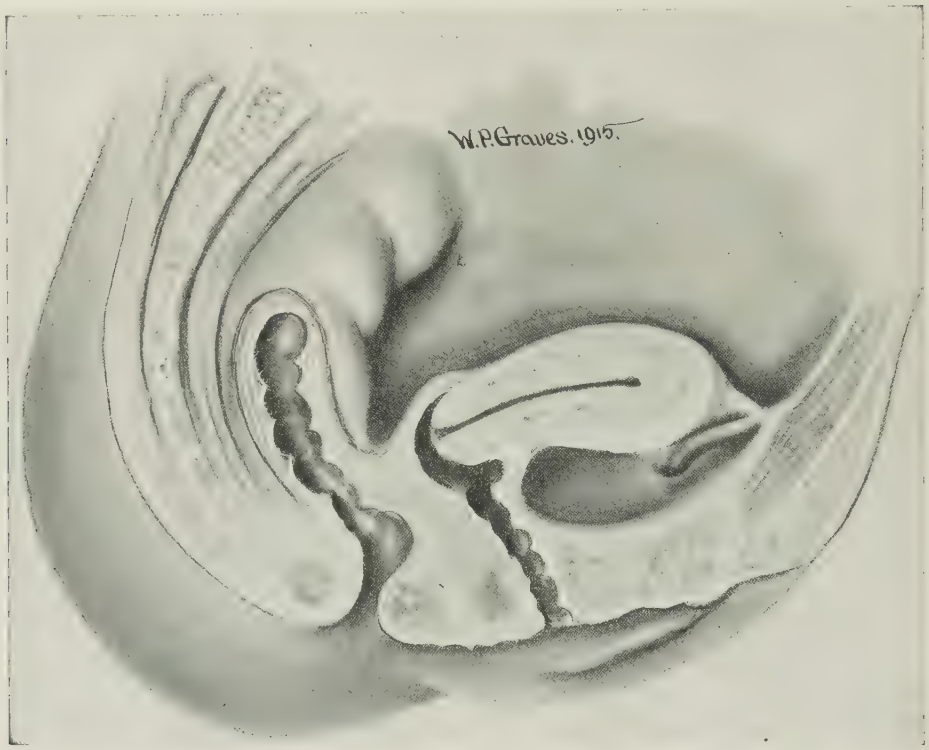


FIG. 396.—ANTEFLEXION OF THE UTERUS REDUCED BY OLSHAUSEN'S OPERATION (AUTHOR'S METHOD).

By drawing the uterus up to the abdominal wall by means of the round ligaments, the anteflexion is completely and permanently straightened out and the whole organ is lifted out of the position of retrocession. By employing the Olshausen method of suspension the necessary position of the uterus can be accurately gaged.

We are accustomed to use the Olshausen operation, as it is possible by this method to secure exactly the required correction of the anteflexion and the most favorable position for the uterus.

## OPERATIONS FOR PROLAPSE AND PROCIDENTIA

### PROCIDENTIA

The technic usually employed by the author for advanced cases of procidentia is as follows:

(1) High amputation of the cervix is performed by the Hegar method described on page 636.

(2) An extensive anterior colpoplasty is then done by the author's method described on page 650.

(3) Perineoplasty is performed according to the technic described for the modified Emmet operation on page 673.

(4) The patient is then placed in the Trendelenburg position, the abdomen opened by a small incision, and the uterus and adnexa removed by the technic described for supravaginal hysterectomy (see page 761).

(5) When the uterus has been amputated, the cervix closed, and the uterine vessels tied, two sutures of No. 7 braided silk are passed deeply, one on each side of the cervix (Fig. 397), the ends being left long and the needles attached. These sutures are to serve later to attach the cervical stump to the anterior abdominal wall.

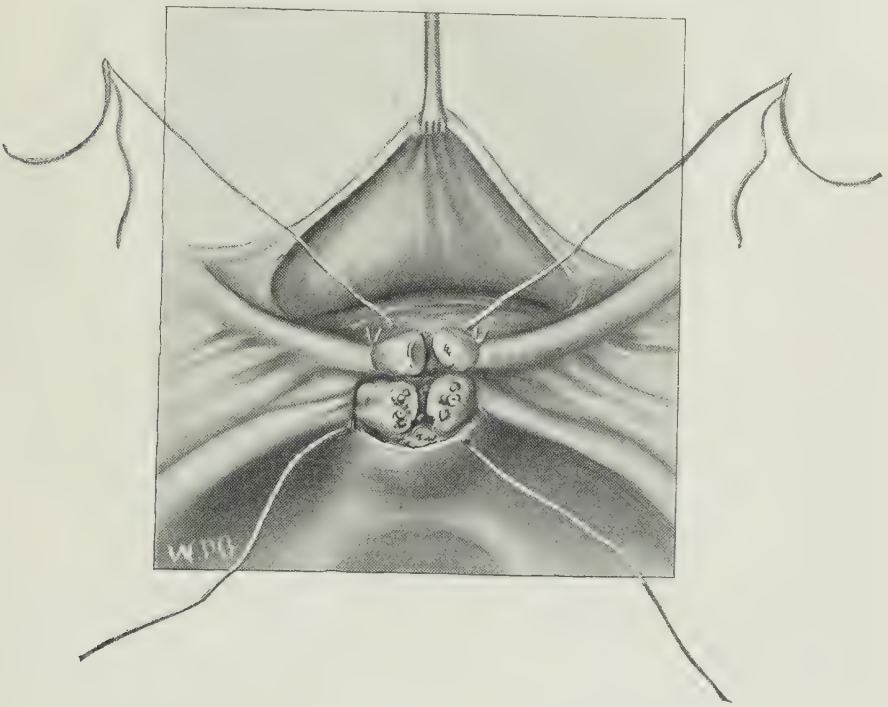

FIG. 397.—OPERATION FOR PROCIDENTIA (AUTHOR'S METHOD).

The uterine body has been amputated and the broad ligaments sewed to the cervical stump. Two strong silk sutures have been introduced through the firm tissue of the cervical stump, which are to be used to attach the stump to the anterior abdominal wall. The bladder flap is being drawn up and is to be attached to the posterior wall of the vagina, so that it entirely covers the cervical stump and the attached stumps of the broad ligaments.

The broad ligaments are then sewed to the stump of the cervix in the same manner as in supravaginal hysterectomy (Fig. 423).

The next step resembles the turning over of the uterovesical flap of peritoneum (Fig. 424), except that in this case the bladder is dissected away from the vagina for a considerable distance. The peritoneal fold is then carried far over the stump of the cervix and attached low down toward the pouch of Douglas to the posterior wall of the vagina. In this way the cervix and broad ligament are, in a sense, interposed under the bladder.

When this step has been completed, the two silk suspensory sutures are passed into the abdominal wall, one on each side of the median incision. Each suture includes the peritoneum, muscle, and fascia. The knots are tied on the inside as tightly as possible, in order to insure a strong artificial suspensory ligament. The portion of the bladder lying between these two sutures is not compressed and suffers no later inconvenience. By this operation the support of the bladder and vagina has a double defense. The primary defense consists

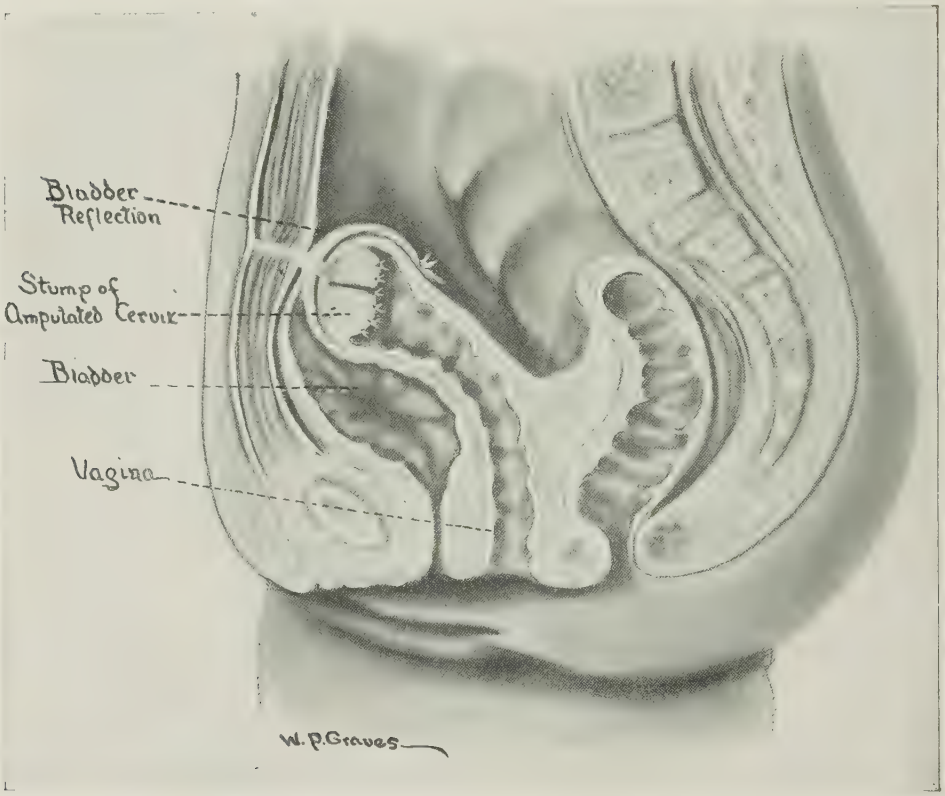


Fig. 398.—Operation for Procidentia (Author's Method).

Sagittal section showing completed operation. The cervix and body of the uterus have been amputated, leaving only a disk of uterine tissue. The bladder has been drawn up over this disk and attached by its flap to the posterior wall of the vagina. The whole mass, including the disk, the attached broad ligament, and the upper wall of the bladder, has been fixed to the anterior abdominal wall. The manner in which the cystocele is reduced by this maneuver is shown in the drawing. The auxiliary operation on the anterior and posterior walls of the vagina is not represented.

of the two artificial ligaments made between the stump of the cervix and the anterior abdominal wall. The secondary defense consists of the broad ligaments brought together by their attachment to the cervical stump, on which a portion of the bladder rests as on a shelf.

The results of this operation are excellent, there being little danger of recurring prolapse of the cervix or anterior wall of the vagina. Recurrence of the rectocele has in a few instances been seen requiring re-operation on the

perineum. The recurrence of rectocele may be avoided by applying several stitches in Douglas' fossa in the manner used in the Moschowitz operation for rectal prolapse (*q. v.*).

If the patient is desirous of having children, the operation for moderate procidentia may be done satisfactorily without removing the uterus. The initial steps of the operation are the same as in that already described—*i. e.*, high amputation of the cervix, anterior colpoplasty, and perineoplasty. Instead of performing a supra-vaginal hysterectomy with abdominal fixation of the cervical stump, it is possible to secure an excellent result by suspending the uterus by

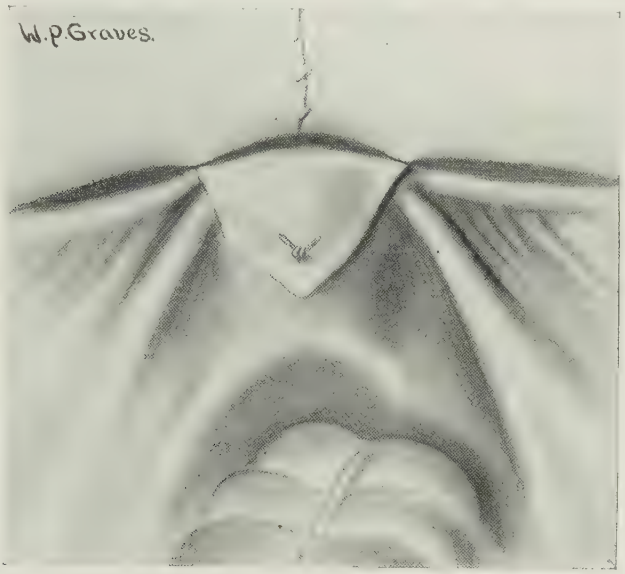


FIG. 399.—OPERATION FOR PROCIDENTIA (AUTHOR'S METHOD).

This is an imaginary view of the completed operation seen from within the abdominal cavity. The bladder flap has been drawn over and attached by one catgut suture behind the cervix. If there is great relaxation of the bladder the flap may be attached much deeper in the culdesac than is shown in the drawing. The two silk sutures shown in Fig. 397 have been introduced into the abdominal wall through peritoneum, muscle, and fascia and tied on the inside, as in the Olshausen operation (Fig. 374). The abdominal wound has been closed. If by an unusual chance this fixation attachment should give way, it may be seen that the broad ligaments form an efficient "secondary defense" to prevent prolapse of the cervix and the vaginal vault.

the Olshausen method sufficiently high up on the abdominal wall to reduce the prolapse. The dangers as to childbirth, if the patient becomes pregnant, are no greater than after any of the suspensory round ligament operations.

### THE WATKINS INTERPOSITION OPERATION FOR PROLAPSE AND PROCIDENTIA

The principle of the Watkins operation is based on a separation of the bladder from the anterior wall of the uterus and transposing its attachment to the posterior wall, so that the uterus is left in a position to support the entire bladder. Watkins performed his first operation in 1898. Several modifications, notably that of Wertheim, have appeared since.

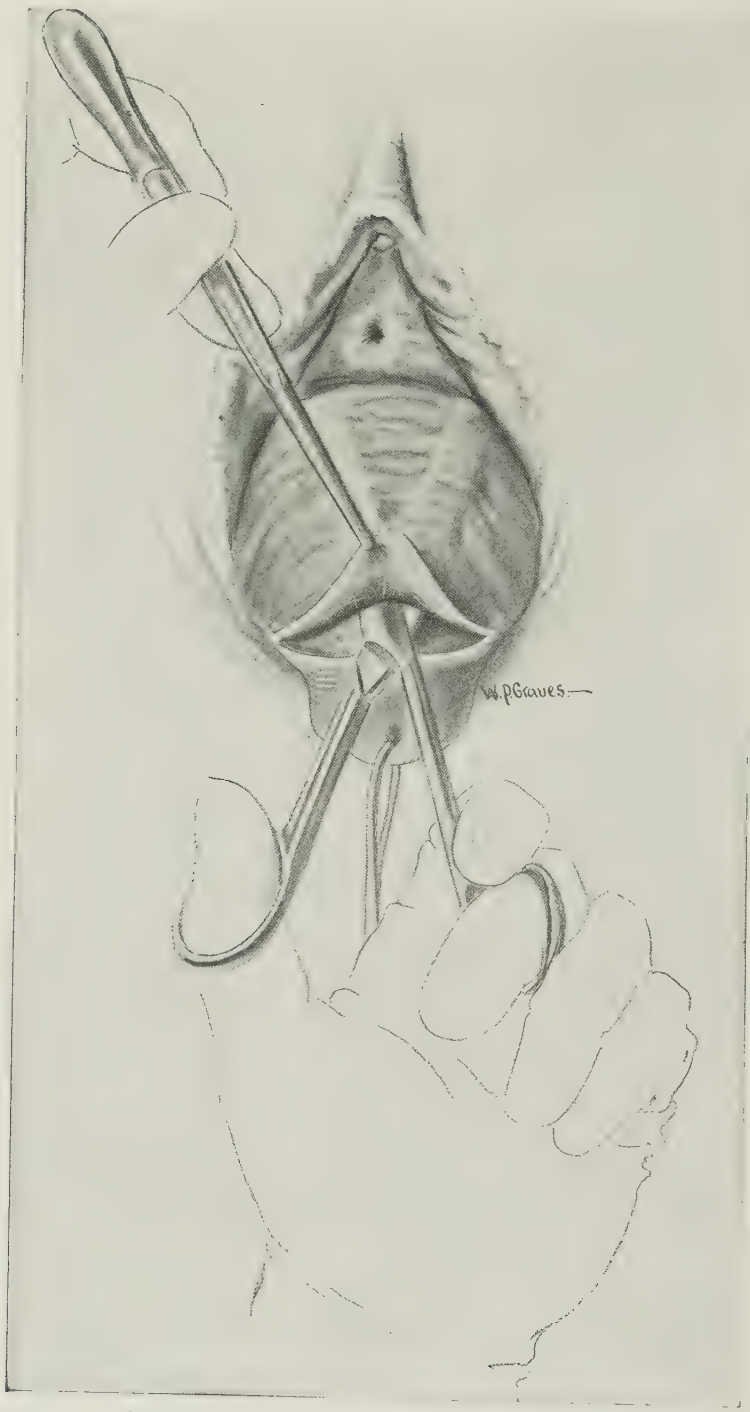


FIG. 400.—WATKINS' OPERATION FOR PROCIDENTIA.
Separating the vaginal wall from the bladder by blunt dissection with scissors.

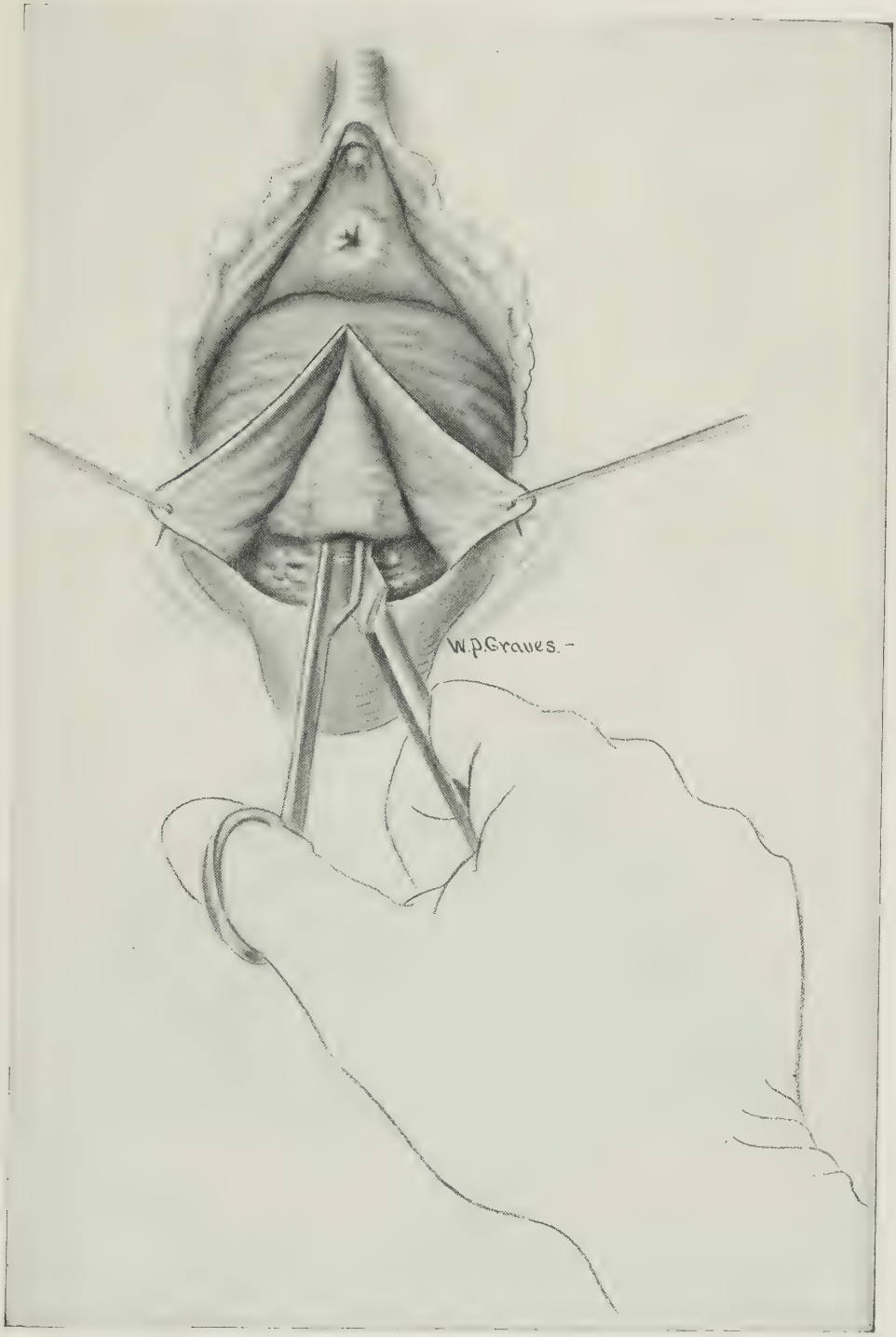


FIG. 401.—WATKINS' OPERATION FOR PROCIDENTIA.
Separating the bladder from the cervix by blunt dissection with scissors.

The technic of the Watkins operation is as follows:

The anterior lip of the cervix is grasped with traction forceps and drawn forcibly down to or out of the introitus. A transverse incision is made at the junction of the bladder and the portio. The ends of the incision are grasped with pressure-forceps and held taut. The end of a pair of scissors, closed, is then inserted in the wound and forced upward toward the meatus, in the plane

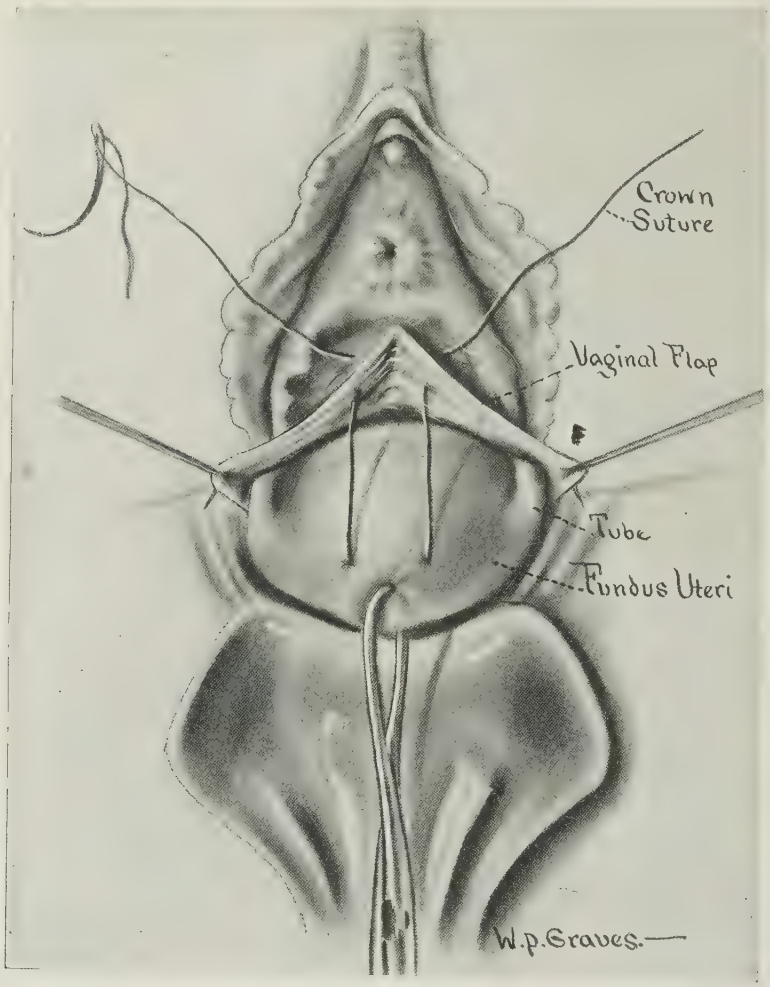


Fig. 402.—Watkins' Operation for Procidentia.
The fundus has been delivered beneath the bladder. The crown stitch has been applied.

of cleavage between the bladder and anterior vaginal wall (Fig. 400). When the level of the urethra is reached the scissors are opened and withdrawn, thus creating an area of separation of bladder and vagina, the amount of which varies according to the size of the cystocele and the amount of adherence between the two layers of tissue. In performing this part of the operation there is considerable danger of injuring the bladder. This must be guarded against

by gentle manipulation of the tissues. When the bladder and vagina have been separated, the anterior vaginal wall is incised along the median line and the edges of the flaps caught with pressure forceps. The flaps are then stripped further back by blunt dissection. The amount of stripping of these flaps should be only enough to cover the anterior wall of the uterus in its new position. In case of an extensive cystocele, where it is desirable later to cut away redundant parts of the wall, the stripping of the flaps is, of course, carried further.

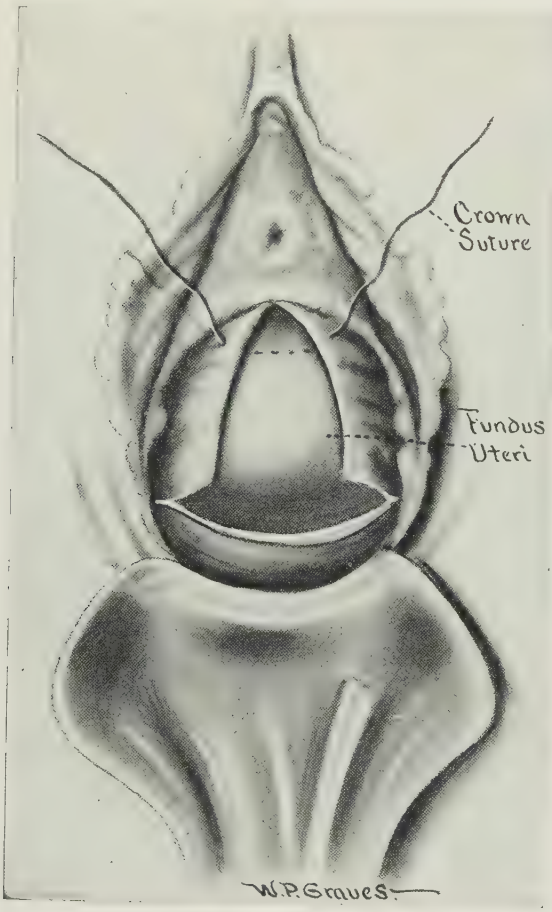


FIG. 403.—WATKINS' OPERATION FOR PROCIDENTIA.
The crown suture.

The next step is to separate the bladder from the cervix. This is done by inserting the scissors in the line of cleavage for a short distance and then opening them (Fig. 401). This process is repeated carefully, and with the points of the scissors pressing against the cervix until the movable plica of the peritoneal reflection from bladder to uterus is reached. The separation of the bladder is not always easy. In cases of difficulty Watkins recommends separating the

lateral portions first, as the adherence of the tissues is less there than along the median line.

Where the peritoneal fold comes into view it is picked up with tissue forceps and cut. The opening thus made is enlarged either by cutting or by forcing it open with the finger.

The next step is the delivery of the uterus through the wound. A narrow retractor is inserted, drawing the bladder well up to the symphysis. The anterior wall of the uterus is first seized with traction forceps and drawn downward and forward, carrying the cervix up and back. By this maneuver one can grasp

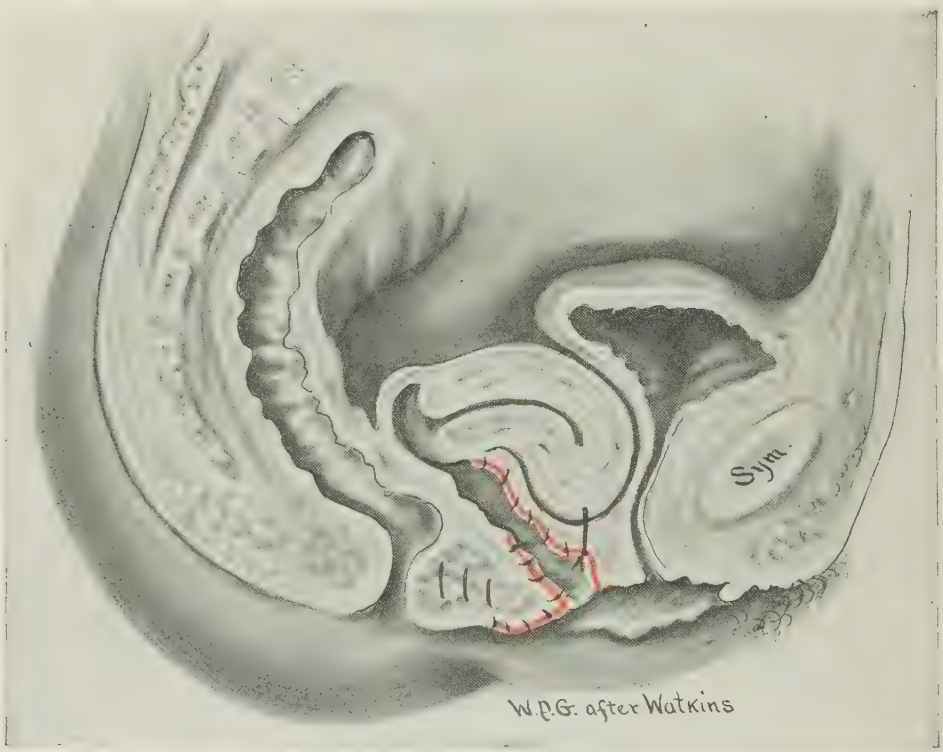


Fig. 404.—Watkins' Operation for Procidentia.
Diagram showing position of organs when the operation is finished.

the fundus of the uterus with traction forceps and deliver it through the wound. Watkins cautions against the attempt of delivering the uterus by the anterior wall because its diameters are greater than those of the fundus.

With the uterus held forward out of the wound, sutures are now placed as in Fig. 402, connecting the upper end of the vaginal wound with the fundus of the uterus. In attaching these sutures one must keep in mind that it is important to superimpose the entire bladder on the uterus, but not to fix the uterus so firmly against the urethra as to interfere with urination.

The vaginal wound is now closed over the anterior surface of the uterus by a

continuous catgut suture, which occasionally catches the peritoneum of the uterus. The transverse incision may be sewed up transversely or longitudinally.

If the operation is done during the reproductive period, the uterine ends of the tubes should be ligated and severed, and peritoneum sewed over the exposed surfaces in order to prevent possible impregnation.

If the cervix is much elongated and hypertrophied, the operation should be preceded by amputation of the cervix.

In all cases a careful perineoplasty should be performed.

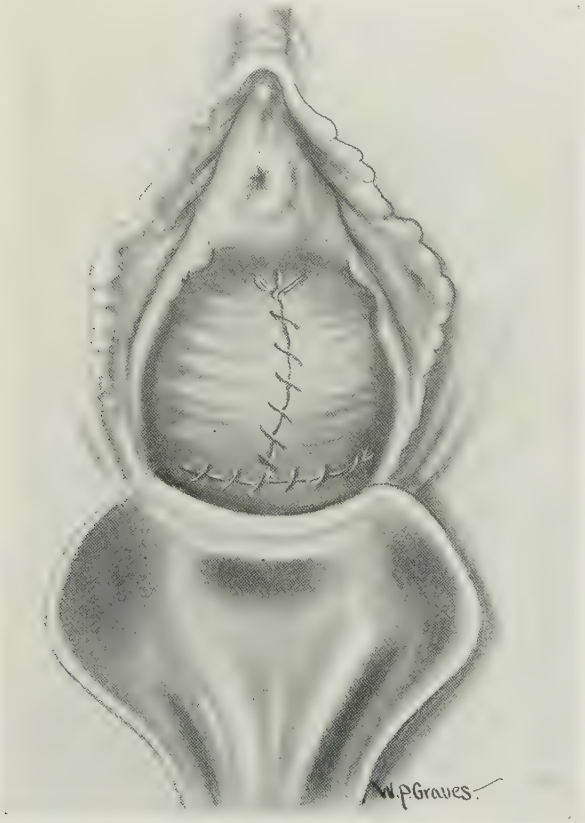


FIG. 405.—WATKINS' OPERATION FOR PROCIDENTIA.
Closure of wound.

Wertheim described an operation in 1899 similar to that of Watkins and based on the same mechanical principles. In the Wertheim operation the bladder is stitched to the posterior wall of the uterus at the level of the internal os (Fig. 406). In closing the vaginal wound a portion of anterior wall of the uterus is left exposed in the vagina (Fig. 407). From a surgical standpoint, Watkins' technic is obviously superior.

## GOFFE'S OPERATION FOR PROLAPSE

A vaginal operation for moderate prolapse and cystocele somewhat similar in mechanical principle to that of Watkins, though not as radical, has been devised by Goffe. The uterovesical pouch is opened as in the Watkins operation, or as described for Anterior Colpotomy (see page 724).

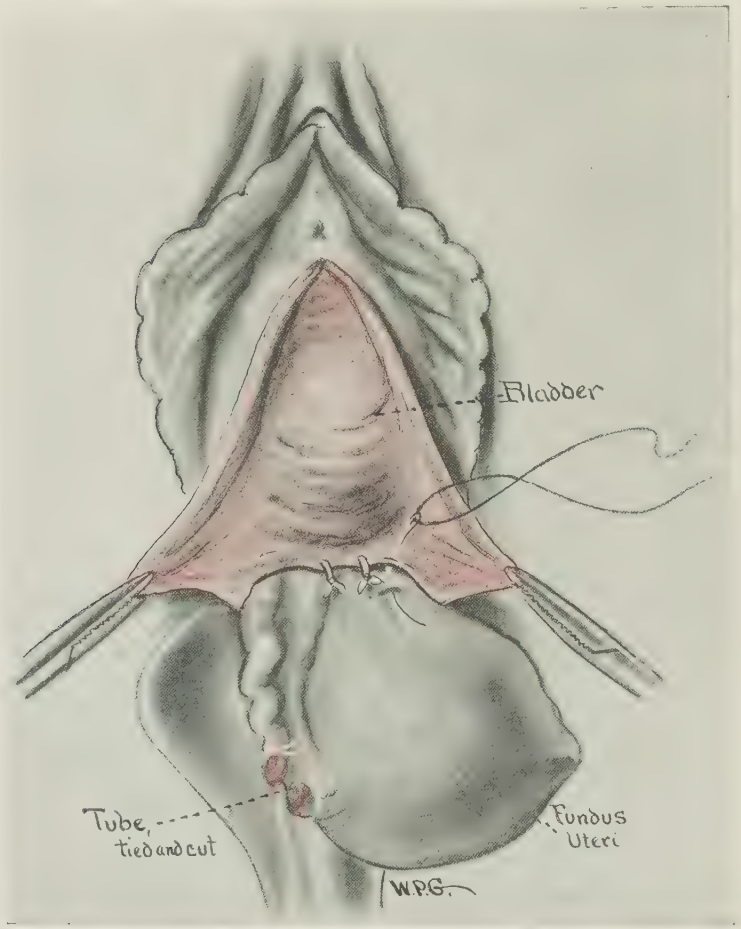


FIG. 406.—WERTHEIM'S OPERATION FOR PROLAPSE AND PROCIDENTIA.
Showing how the edge of the peritoneal reflection is stitched to the posterior wall of the uterus (adapted from Döderlein-Krönig).

The uterus is then delivered, and a shortening of the round ligaments by reduplication performed through the vaginal opening. The principle involved in this operation is to shift the bladder around on the uterus so as to form a new attachment not only in the median line, but also at the two cornua of the bladder.

A description of the steps of the operation from this point is quoted from Goffe:

"The object of the next procedure is to carry up into the pelvis and to fix the firm immovable base of the bladder. To accomplish this a point is selected in the middle of the base of the bladder wall which, when carried up to the torn edge of the peritoneum on the anterior face of the uterus, middle point, will take up all the slack in the base of the bladder, making a comparatively straight line from the urethra to the uterus. Through this point a suture is passed and carried also through the selected point on the anterior face of the

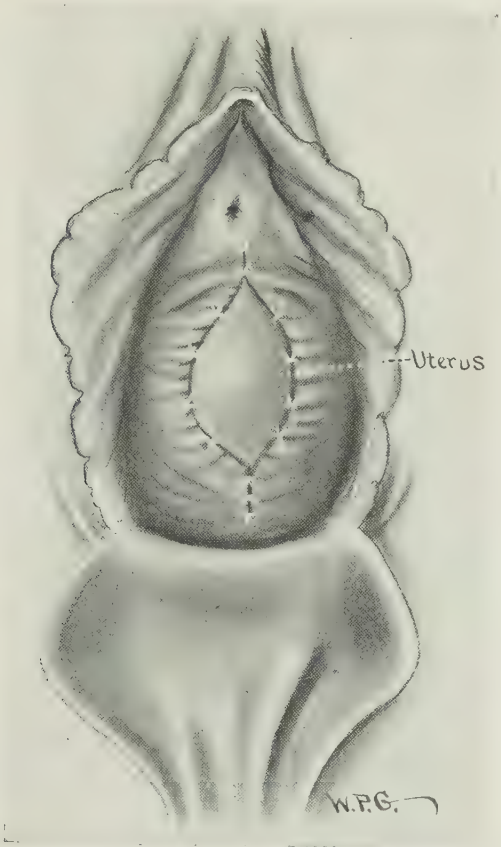


FIG. 407.—WERTHEIM'S OPERATION FOR PROLAPSE AND PROCIDENTIA.
In this operation the peritoneum of a portion of the fundus of the uterus is left exposed in the vagina. Compare this with Fig. 405, which shows the Watkins method of vaginal closure.

uterus, catching up in its course the corresponding torn edge of the peritoneum on the bladder. This suture is left long and is not tied until all the sutures are passed. Two points are then selected in the base of the bladder on either side on a transverse line with the first selected point and equally distant. These two points indicate the cornua of the bladder. Through them similar sutures are passed and carried through the round ligaments or points on the torn-off edges of peritoneum on the surface of either broad ligament sufficiently distant from the middle point to take up all the slack in the base of the bladder, from

side to side; these sutures are also left long. The three sutures are then tied successively, beginning with the middle one. The effect of this is to stretch the base of the bladder taut and smooth in every direction. This restores the support of the bladder which is derived from the uterus. In addition to this, it is necessary to overcome the condition of hernia, and secure to the bladder the support which it receives from the fascia lata. This is accomplished in the

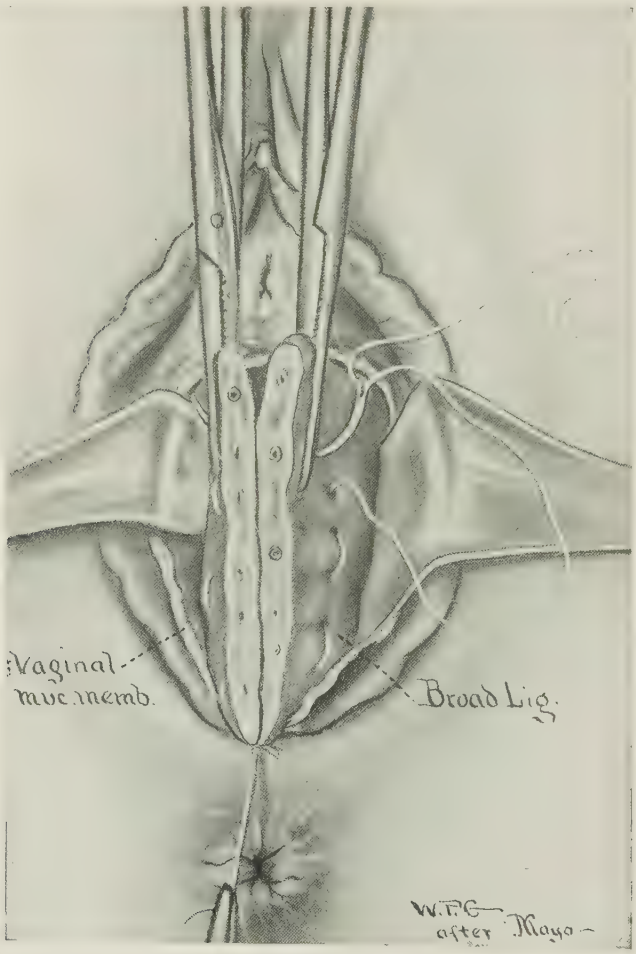


FIG. 408.—THE MAYOS' VAGINAL OPERATION FOR PROCIDENTIA.
The broad ligaments are being united by a running mattress suture (adapted from the Mayos).

following manner: The fascia along the middle line of the vaginal incision and the mucous membrane as well are then trimmed off at either side sufficiently to remove the overstretched and ruptured part of the fascia and secure for support the strong uninjured portion of the fascia lata. The freshened edges of the fascia lata and vaginal mucous membrane are then stitched together throughout the whole length of the vagina, thus bringing it up snugly against the base

of the bladder. The uterine end of the vaginal incision is then stitched to the uterus directly under the attachment of the bladder."

For complete procidentia Goffe applies the same principle in a more radical way: The uterus is first removed by vaginal hysterectomy (see page 776). The two broad ligaments are then stitched together across the pelvis. Upon this newly constructed plane the bladder wall is spread out and stitched, in practically the same manner used in the prolapse operation, in which the bladder

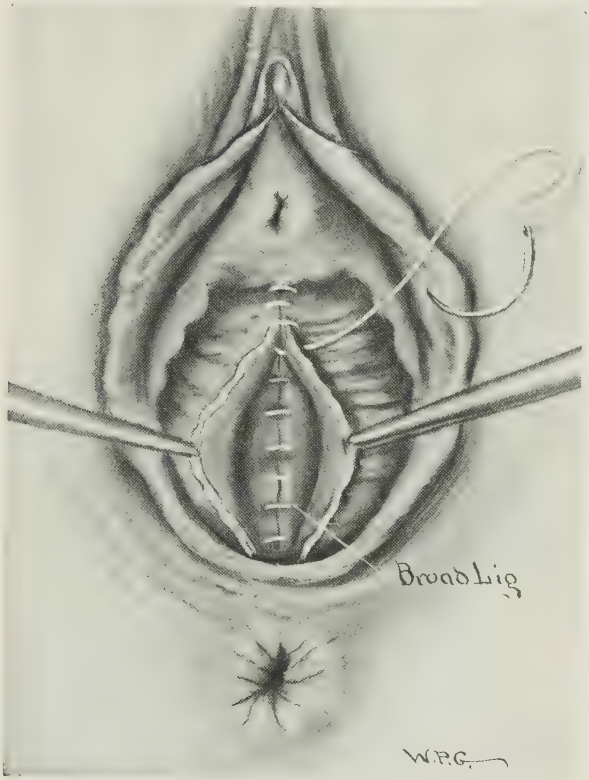


FIG. 409.—THE MAYOS' OPERATION FOR PROCIDENTIA.
The broad ligaments have been united in the middle line. The vaginal mucous membrane is being approximated by a running stitch (adapted from the Mayos).

was attached to the anterior uterine wall. To this plane is also attached the upper end of the vagina.

### THE MAYOS' OPERATION FOR PROCIDENTIA

An operation for procidentia combining the principles of the Watkins and Goffe operations is that devised by the Mayos.

A vaginal hysterectomy is performed as described on page 776, except that clamps are used on the broad ligaments instead of ligatures. The edges of the broad ligaments are then approximated laterally, and a running mattress suture of chromicized catgut passed through both ligaments, along a line suffi-

ciently far back of the clamps so that when drawn taut the broad ligaments are tightened (Fig. 408). This mattress-stitch runs at a distance of 1 to 11 inches from the edges of the ligaments, and is designed also to secure the vessels without possibility of slipping.

The upper border of the united broad ligaments is then stitched to the vaginal wall at the level of the upper angle of the vaginal wound. This compels the bladder to rest on the broad ligaments as on a kind of shelf. The loose

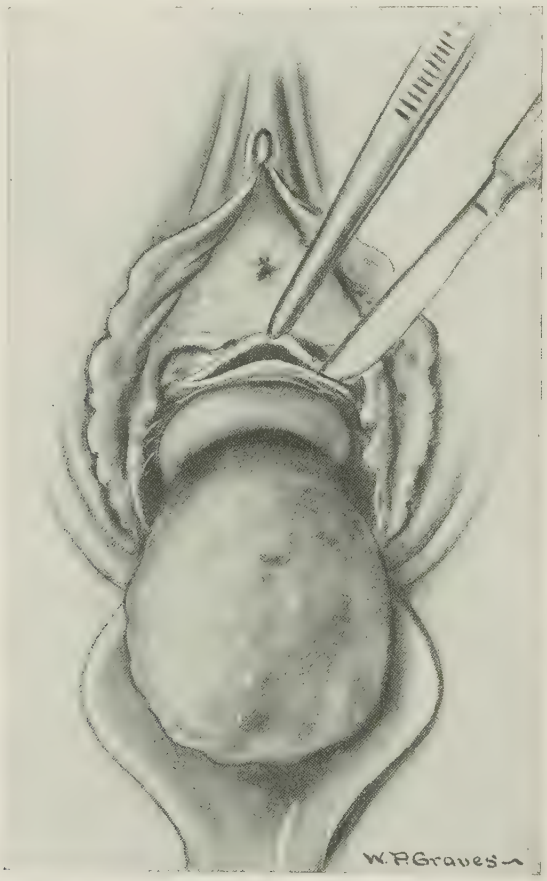


Fig. 410.—Spinelli's Operation for Inversion.
The initial incision.

edges of the broad ligament are now stitched smoothly together, and the vaginal flaps closed by a running suture (Fig. 409).

### CONSERVATIVE OPERATION FOR INVERSION OF THE UTERUS

The technic of the operation devised by Küstner for inversion is as follows:

A wide transverse incision is made opening the pouch of Douglas. The forefinger of the left hand is introduced through this incision into the cup-shaped depression caused by the inversion of the fundus. If the uterus can be

brought outside of the vulva, the inverted fundus will appear uppermost, the posterior aspect of the uterus and cervix being toward the operator. A longitudinal incision is then made exactly in the middle line, dividing the posterior wall of the cervix and a part of the posterior wall of the fundus. With the forefinger in the cup-shaped depression on the abdominal side, and the thumb on the fundus of the exposed side, the uterus can now be reinverted to its original condition. The reinverted fundus is retroflexed and drawn out through the poste-

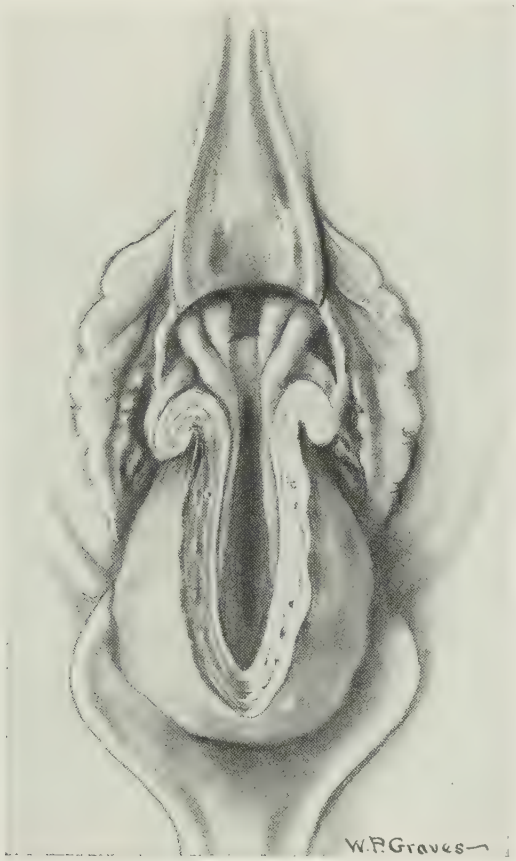


Fig. 411.—Spinelli's Operation for Inversion.
The anterior wall of the uterus has been opened preparatory to reinverting it.

rior colpotomy opening, and the wound of the posterior wall and cervix closed with deep catgut sutures. The posterior colpotomy wound is sewed.

This operation has been modified by other operators, who recommend making an anterior vaginal incision.

### SPINELLI'S OPERATION FOR INVERSION OF THE UTERUS

Spinelli's modification of Küstner's principle of vaginal operation for inversion is the method most commonly in use at present.

A transverse anterior vaginal incision (Fig. 410) is first made and the bladder separated from the uterus, as described for Anterior Colpotomy (see page 724). A median incision is then made through the cervix, dividing completely the constricting ring. This incision should be carried toward the fundus, through the anterior uterine wall, until a point is reached which will allow the reinversion of the uterus. It is, as a rule, necessary to continue the incision as far as the fundus.

FIG. 412.—SPINELLI'S OPERATION FOR INVERSION.

The uterus has been reinverted. In order to secure approximation of the edges of the wound in the uterine wall it has been necessary to remove wedges of tissue on each side, as is shown in the drawing.

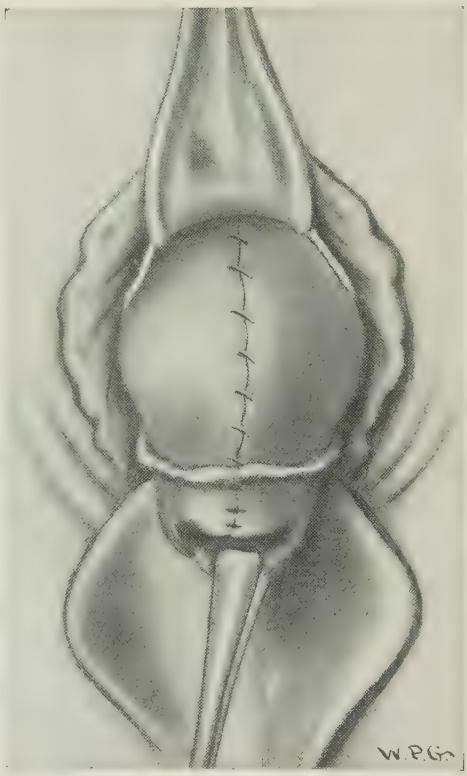

FIG. 413.—SPINELLI'S OPERATION FOR INVERSION.

Closure of the incision of the cervix and anterior wall.

The uterus is reinverted by placing the forefingers at the cervix for counterpressure, and forcing the fundus upward by the thumbs in the manner that one would naturally use in turning a tennis ball inside out through a cut in its side.

When the uterus has been restored to its original form, the next step is to close the incision in its wall. It will, however, be found that, owing to the shrinking which the peritoneum has undergone in its inverted position, it can-

not be approximated, the tissue of the uterine wall pouting out in the manner of an ectropion. The excessive tissue must be trimmed away in the form of longitudinal wedges, as seen in Fig. 412, when the peritoneal edges may be coaptated without difficulty. The wound of the uterine wall is closed with two rows of continuous catgut sutures. The first suture includes and firmly unites the muscular wall, while the second is superficial and approximates the peritoneal surfaces. The wound of the cervix is closed with interrupted catgut sutures. A cigarette-wick is left in for drainage, as there is always danger of

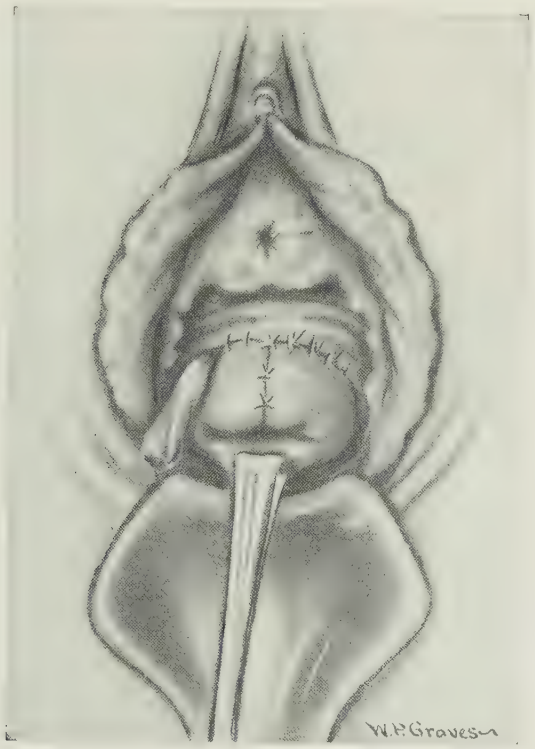


Fig. 414.—Spinelli's Operation for Inversion.
The vaginal incision has been sutured and a small rubber drain inserted at one angle.

sepsis. Crossen recommends drainage both from the anterior and posterior culdesac. The vaginal wound is sutured except for the portion occupied by the drain.

## HYSTERECTOMY OPERATIONS

### SUPRAVAGINAL HYSTERECTOMY

The patient is in a pronounced Trendelenburg position. The length of the median abdominal incision depends upon the size of the mass to be removed from the pelvis. If there is no enlargement of the pelvic organs the incision need not be greater than $3\frac{1}{2}$ inches unless the patient is fat. In all cases the

incision through the aponeurosis should be carried down as far as possible to the pubes, for it is at the lower end of the wound that most room is needed. The intestines, which should be carefully prepared, are walled off with gauze. The fundus of the uterus is then seized with volsella, unless there is question of infection or necrosis of the tissue, in which case they should not be used. The uterus is first drawn sharply to the left, thus exerting tension on the broad ligament and bringing the round and infundibulopelvic ligaments into prominence. A single half-length clamp is applied near the ovary, including the round ligament close to the uterus and the infundibulopelvic ligament, in which run the ovarian vessels. The clamp should be so applied that the two

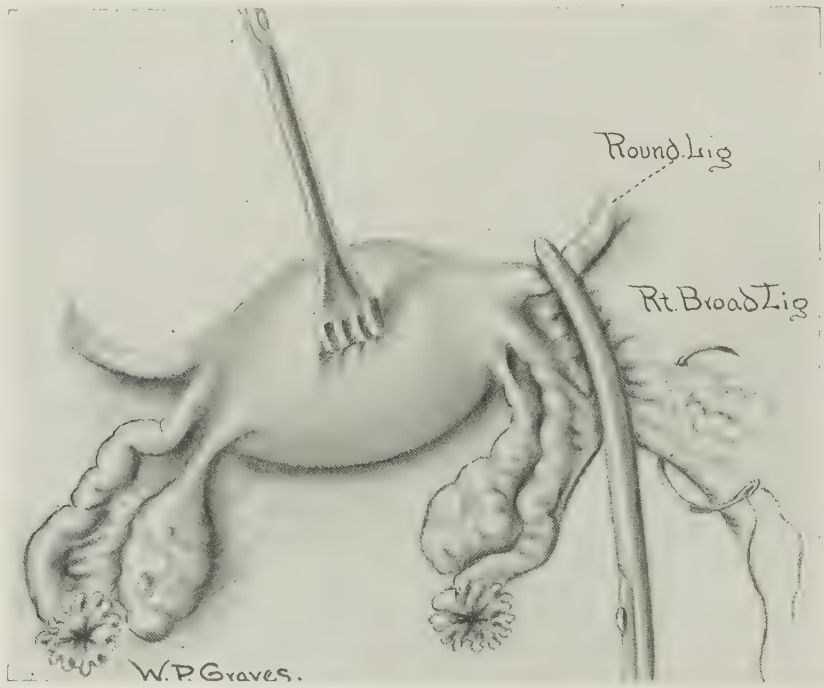


FIG. 415.—SUPRAVAGINAL HYSTERECTOMY. FIRST STEP.
A single half-length clamp is placed on the broad ligament close to the uterus. The first ligature for tying the infundibulopelvic ligament is being placed.

ligaments meet each other at an angle (Fig. 415). A ligature of No. 2 catgut is then passed with a needle around the infundibulopelvic ligament and tied, the needle entering the leaves of the broad ligament in the so-called clear space in which there are no veins. The ligament is cut and tied again to insure against secondary hemorrhage from the ovarian vessels; the round ligament is then tied with one ligature and cut. After cutting the round ligament, the region of the uterine vessels is exposed by cutting the leaves of the broad ligament *as close to the round ligament* as possible. If the division of the broad ligaments is carried down too close to the uterus, several branches of the uterine vessels are inevitably wounded and require extra clamps to control the hemor-

rhage. (It is important to limit the number of clamps as much as possible, for they greatly hamper the progress and smooth technic of the operation.) When the leaves of the broad ligament have been slit down close to the round ligament the edges fall apart and expose the uterine vessels.

The uterus is now drawn toward the right and the left adnexa treated in the same way. At this stage of the operation there are in the wound only the two clamps on the uterine adnexa in addition to the traction forceps which grasps the fundus of the uterus. The uterus is then drawn backward, exposing

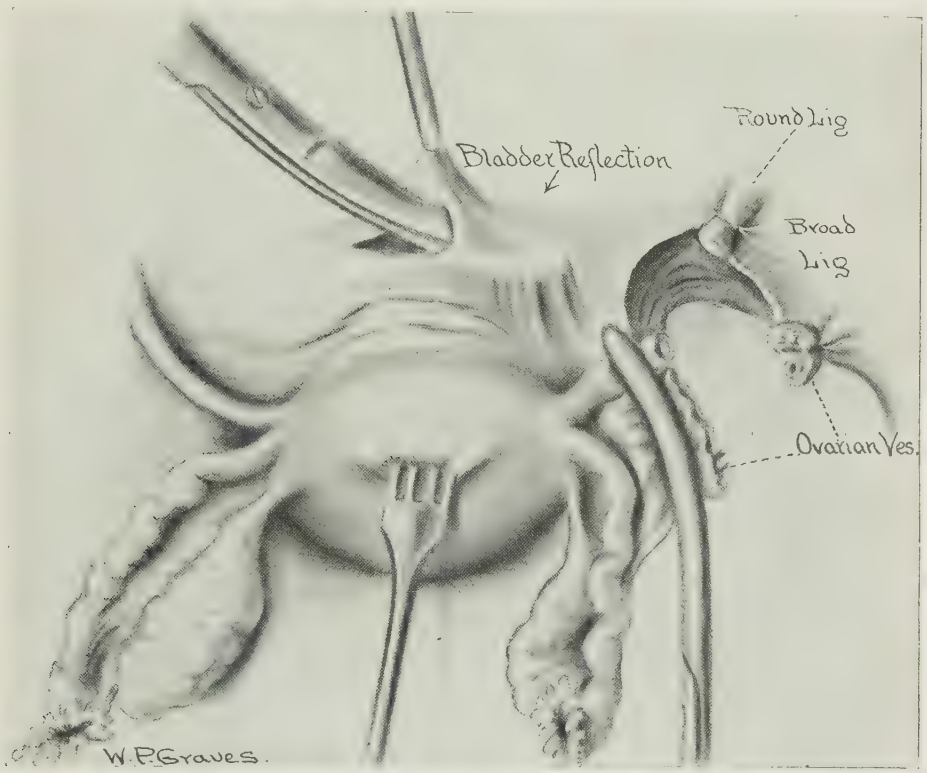


FIG. 416.—SUPRAVAGINAL HYSTERECTOMY.
Dissection of the uterovesical fold of peritoneum. The blades of the scissors are pushed under the peritoneum before cutting it, thus avoiding unnecessary bleeding.

the bladder. The uterovesical reflection of peritoneum is picked up with thumb forceps close to the bladder, where it is loosely attached, and opened sufficiently to admit the end of a pair of blunt curved scissors, which are pushed under the peritoneum to the cut surfaces on each side of the uterus (Fig. 416). This dissects up the peritoneum so that it is easily cut, with the complete avoidance of bleeding. *It is not necessary to dissect a flap of peritoneum on the posterior wall of the uterus.*

The uterus is now ready for amputation. A half-length clamp is applied to the left uterine vessels, where they ascend the uterus at the level of the

internal os. A second, toothed, clamp is applied to the same vessels ¾ inch higher on the uterine wall, and the vessels are severed close to the second clamp so as to leave the proximal stump as long as possible. The traction forceps on the fundus of the uterus is then seized in the left hand of the operator and drawn as sharply to the right as possible in order to expose the cervix and give room for the amputation. A wedge-shaped incision is made across the cervix

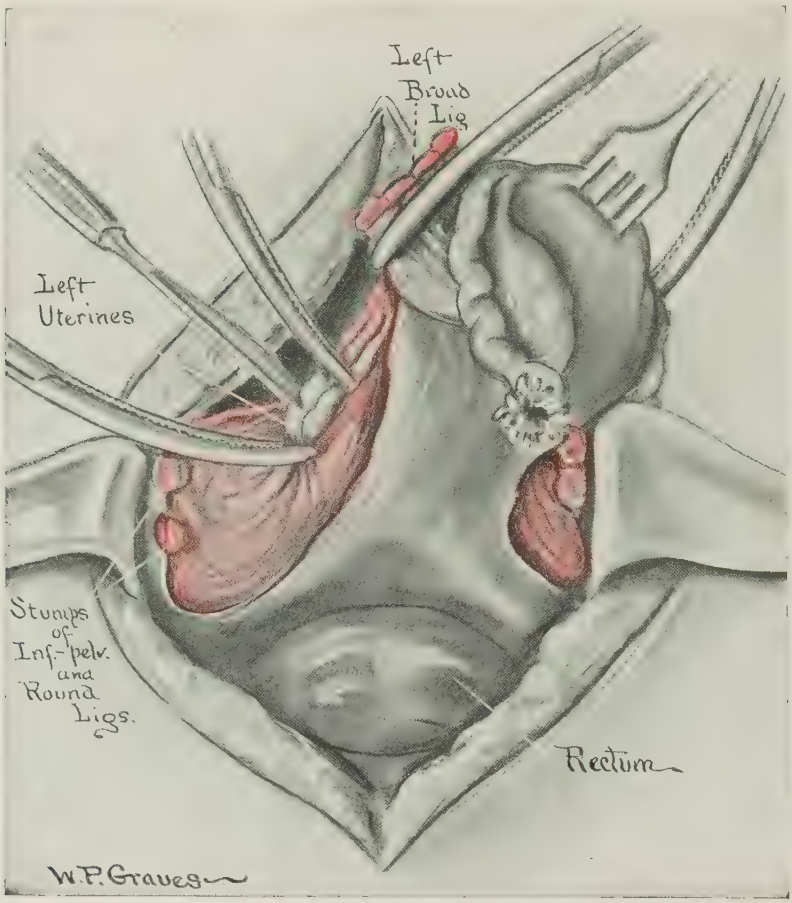


FIG. 417.—SUPRAVAGINAL HYSTERECTOMY. FIRST STEP OF AMPUTATION.

The uterine vessels, having been exposed, are grasped with two clamps and are being severed. Care must be taken to leave the ends of the vessels sufficiently long above the lower clamp so that they may easily be seized by the "secondary defense" clamp seen in Fig. 421.

until the cervical tissue is entirely severed. The uterus is now held only by the right uterine vessels (Fig. 419). They are clamped and cut so as to leave a long pedicle beyond the clamp. With the removal of the uterus and appendages only two clamps remain in the pelvis controlling the uterine vessels. A third, toothed, clamp is now attached to the posterior lip of the cervical stump for the purpose of traction. If there is any question about the possibility of infection from

the cervical canal, it may be cauterized or treated with crude carbolic acid or alcohol or iodin.

The lips of the cervical stump are united with two or three interrupted sutures and then the uterine vessels are tied. The technic of tying these vessels is important. While amputating the uterus pains were taken to leave the pedicles of the vessels extending beyond the clamps as long as possible. Beginning now on the right, the redundant pedicle of the vessels is included in another pair of

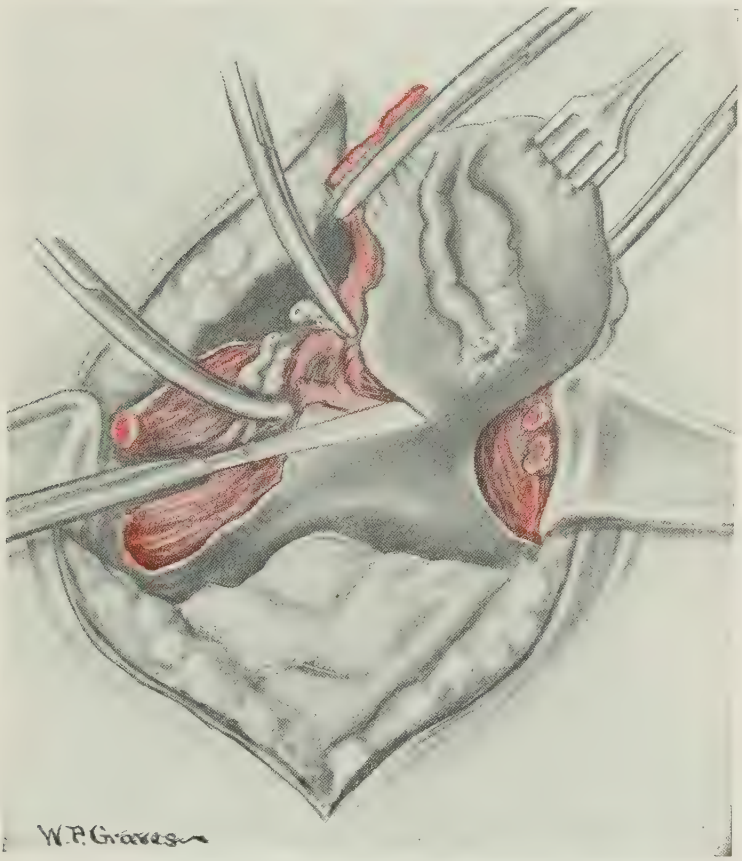


FIG. 418.—SUPRAVAGINAL HYSTERECTOMY. SECOND STEP OF AMPUTATION.
The vessels of the left side have been severed and the uterus is being amputated by a wedge-shaped incision.

clamps to act as a sort of secondary defense. A ligature is introduced with a full-curved needle first into the tissue of the cervix inside the vessels, then around the vessels and tied. As the knot is tied the first or lower clamp is released. The ligature is then passed again in the same manner, and when tied the secondary clamp is removed. In this manner the uterine vessels are tied twice. By using the secondary clamp no blood is lost. The same procedure is carried out on the left.

The next step, and a most important one, is the suspension of the cervical stump by the broad ligaments in order to avoid a later prolapse, a complication

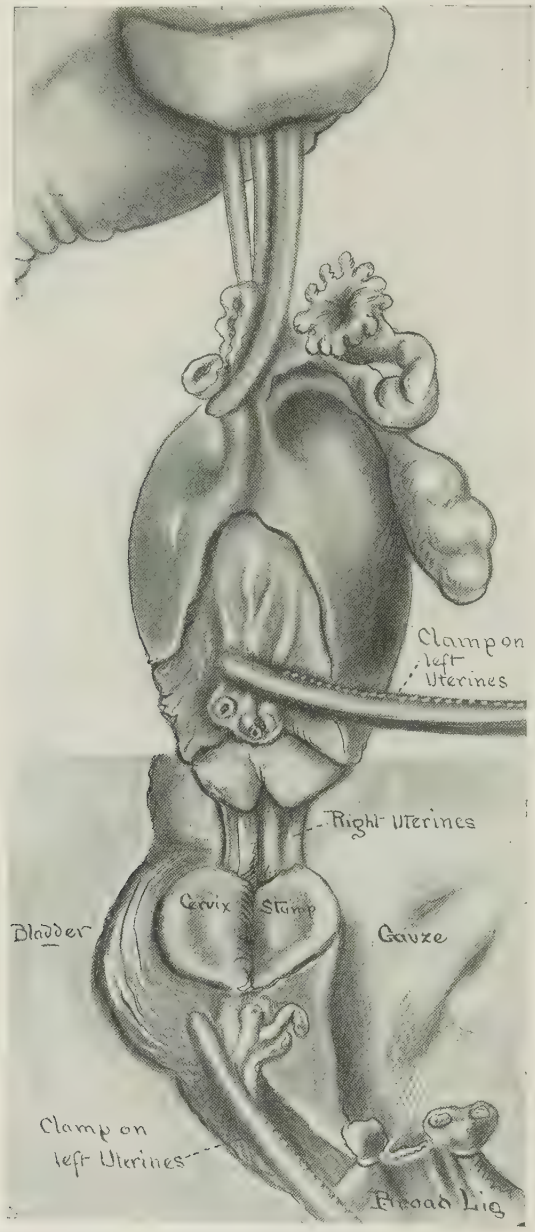


FIG. 419.—SUPRAVAGINAL HYSTERECTOMY.

The left uterines have been clamped and cut. The uterus has been amputated by a wedge-shaped incision. The uterines of the right side have been reached and exposed by lifting the uterus. A clamp now grasps the vessels, which are severed with as long a pedicle as possible.

which, as we have emphasized (see page 131), is the most common cause for the physical and nervous symptoms following hysterectomy.

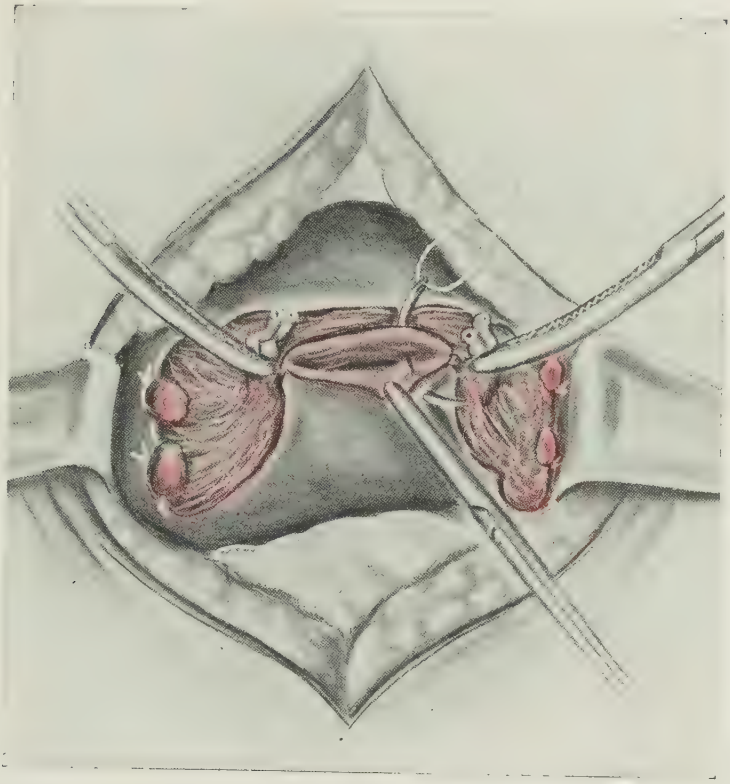

FIG. 420.—SUPRAVAGINAL HYSTERECTOMY.
The uterus has been amputated by a wedge-shaped incision. Two or three interrupted sutures close the walls of the cervical stump. The first suture is being placed.

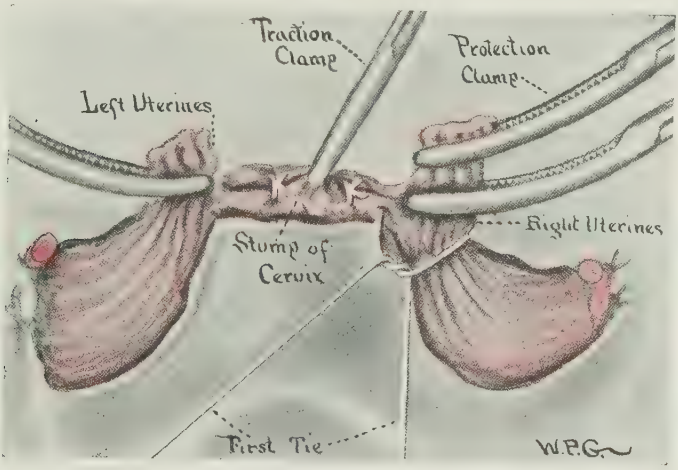


FIG. 421.—SUPRAVAGINAL HYSTERECTOMY.
The uterines of the right side are about to be tied. The "secondary defense" clamp has been applied to the ends of the vessels. When the ligature has been tied the lower clamp is removed. A second tie is then made for extra safety.

Beginning on the right, the round and infundibulopelvic ligaments, which have been tied so as to meet each other at an angle, are grasped with clamps.

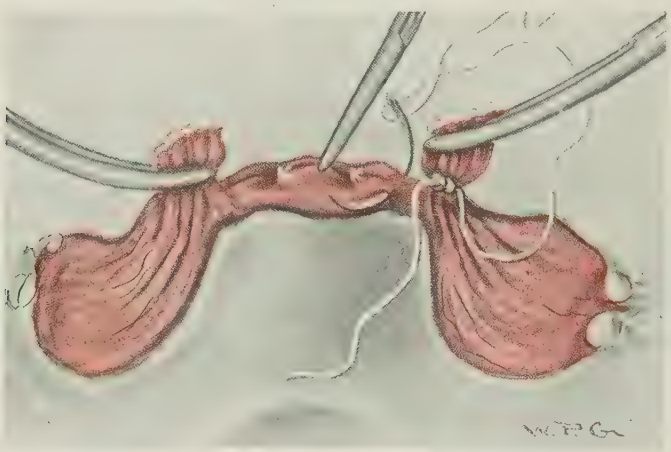

FIG. 422.—SUPRAVAGINAL HYSTERECTOMY.

The uterine body has been amputated. The lips of the cervical stump have been closed by two interrupted sutures. The right uterine vessels have been tied once and the ligature is being introduced for a second tie. The stump of the uterine vessels is controlled by the "secondary defense" clamp.

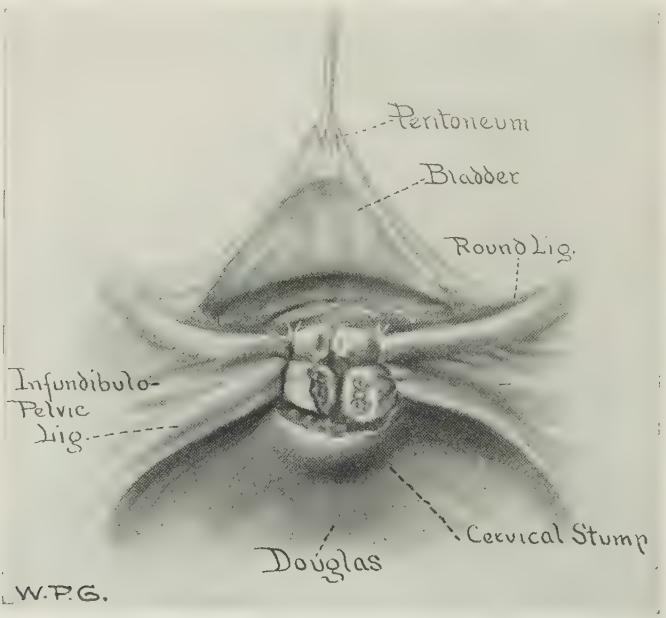


FIG. 423.—SUPRAVAGINAL HYSTERECTOMY.

The stumps of the broad ligament have been sewed to the stump of the cervix. The bladder flap of peritoneum is being lifted up preparatory to stitching it to the posterior wall of the cervical stump.

A strong catgut ligature is applied on a needle which first passes through the tissue of the cervical stump, then through the round ligament near the tied end, and including a little of the peritoneum covering the infundibulopelvic

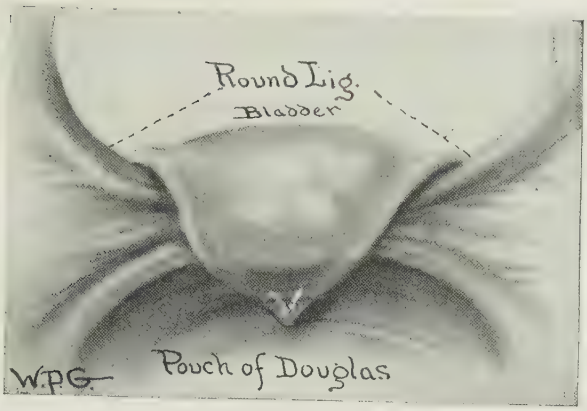


FIG. 424.—SUPRAVAGINAL HYSTERECTOMY.
Operation completed. The bladder flap of peritoneum has been attached with one suture to the posterior wall of the cervical stump.

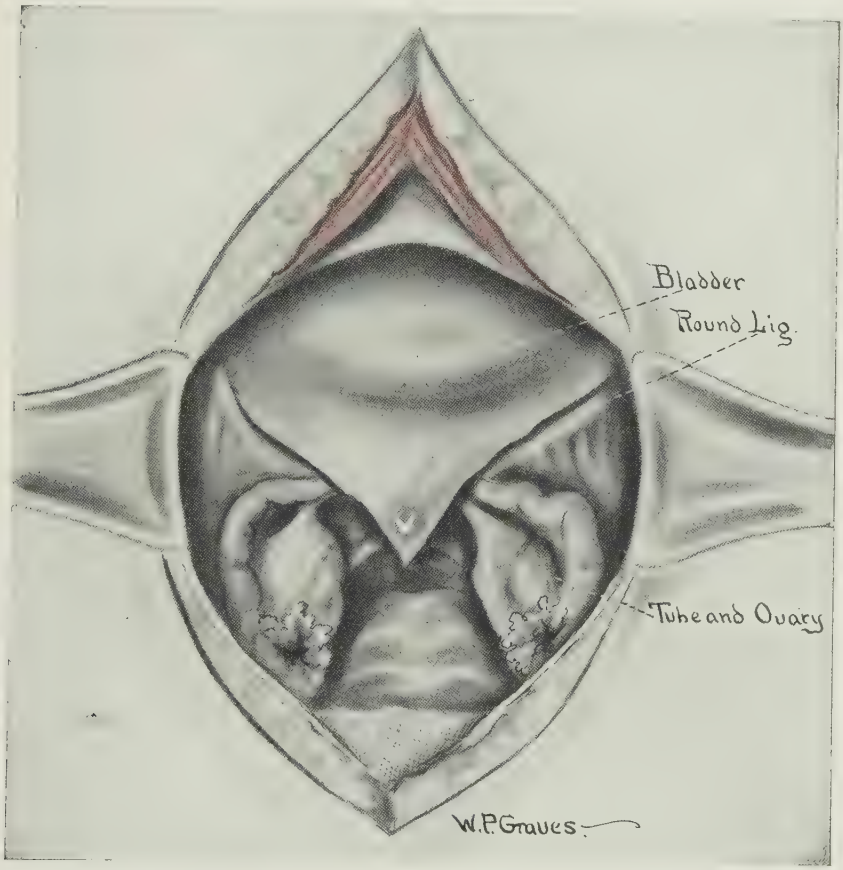


FIG. 425.—SUPRAVAGINAL HYSTERECTOMY.
Method of leaving in the adnexa of both sides.

ligament. The cervical stump and the ends of the two ligaments are approximated and the ligature is tied. The needle-end of the ligature is left long, and

again passed through the cervix and around the ends of the ligaments of the left side, which are also tied to the cervical stump in the same way.

The final step of the operation is to grasp the loose flap of peritoneum which is reflected over the bladder, and draw it up toward the wound. This gives a chance, by the translucency of the peritoneum, to determine just where the edge of the bladder lies. A suture is passed through the margin of the peritoneum, across the posterior wall of the cervix, and out again through the margin. When tied the peritoneal flap covers the united cervical and liga-

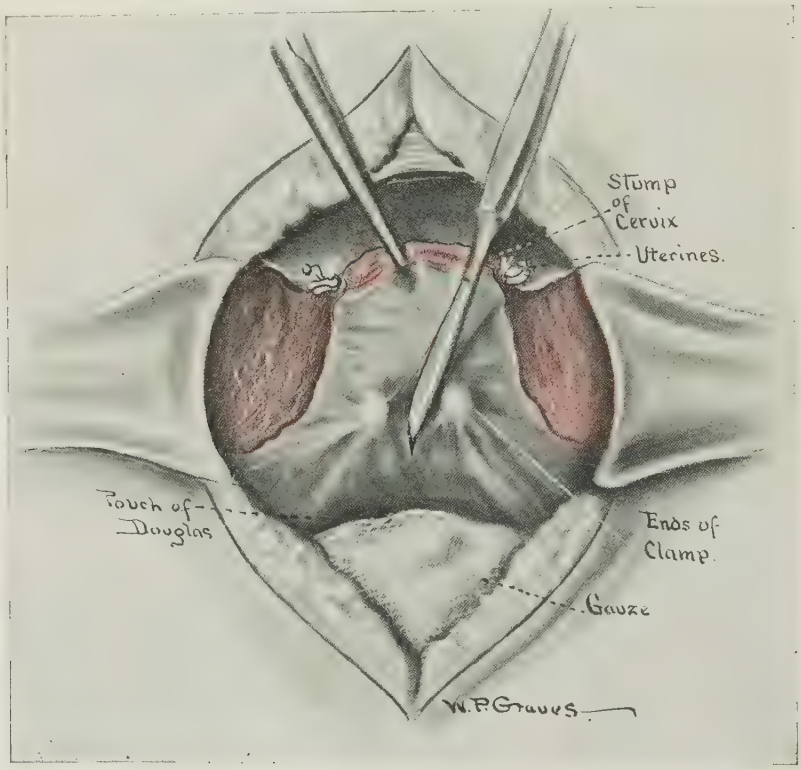


Fig. 426.—Vaginal Drainage After Supra-vaginal Amputation.

The stump of the cervix is drawn upward and forward by a toothed clamp inserted in the posterior wall. A long clamp has been introduced into the vagina, pressed against the posterior wall, and unclasped. An incision is being made through the vaginal wall between the opened ends of the clamp.

mentary stumps and is attached to the posterior surface of the cervix (Fig. 424). This completes the operation. By this technic very little blood is lost, and the cervix and vagina are permanently held in a high position in the pelvis.

An additional point of value in the technic is that only one catgut knot is left exposed and is in a position where it can do little harm. This is an important factor in the avoidance of postoperative adhesions.

In sewing up the abdominal wound after an operation in the Trendelenburg position the patient should be returned to the horizontal position before the skin and fat are sutured. It will be found in most cases when this is done that

on account of the change in position a little bleeding takes place from the subcutaneous vessels which require tying. If this precaution is not taken it will happen occasionally that the skin sutures will not control this adventitious bleeding, and a blood-clot will form in the wound which may cause delay in the convalescence.

**Vaginal Drainage.**—Whenever drainage of the pelvis is necessary it should be made, if possible, through the vagina. Abdominal drainage should be resorted to only in the most severe inflammatory cases, or when the posterior culdesac

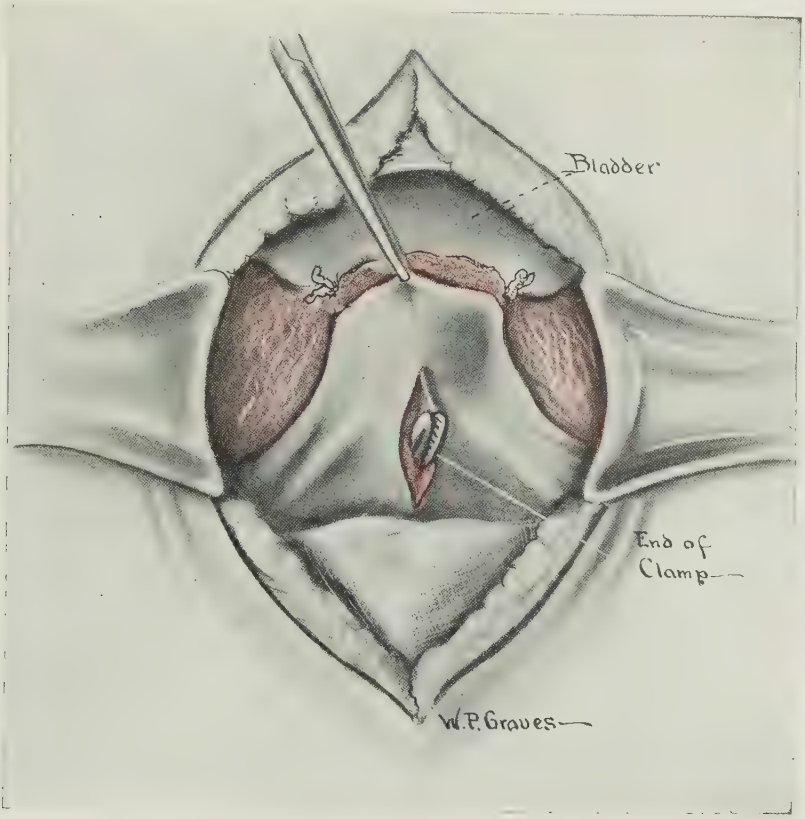


Fig. 427.—Vaginal Drainage After Supravaginal Hysterectomy.
The tips of the clamp in the vagina are seen just emerging through the opening in the posterior vaginal wall.

is so occluded with adhesions that opening the vagina would entail too great risk of injuring the rectum.

The method of instituting vaginal drainage during the operation of supravaginal hysterectomy is as follows:

After the cervical stump has been closed and the uterine vessels have been tied, an assistant introduces into the vagina a long curved clamp with the tip turned toward the abdominal wound (Fig. 426). As the introduction of the clamp must be made under the operating sheet covering the patient, the assist-

ant must be careful not to enter the urethra instead of the vagina. The stump of the cervix is drawn strongly upward and the ends of the clamps are pressed against the posterior vaginal wall near the cervix. The clamp is then unclasped and the surgeon makes an incision between the ends of the clamp through the vaginal wall (Fig. 426). The assistant closes the clamp, forces it through the vaginal opening into the posterior culdesac and receives a cigarette-drain, which he draws down into the vagina (Fig. 428). The rest of the operation is then completed and the abdominal wound closed. In most cases the drain is removed

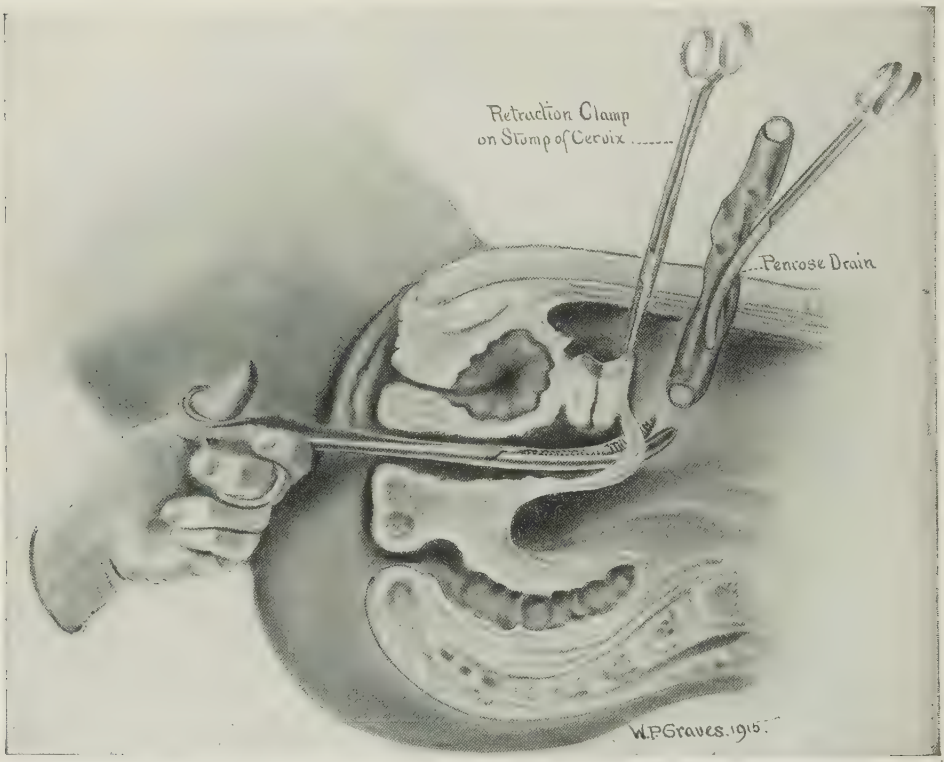


Fig. 428.—Vaginal Drainage After Supravaginal Hysterectomy.
A cigarette drain is being passed by the surgeon to a clamp, which has penetrated an opening made in the posterior vaginal wall.

in two or three days and does not have to be replaced. By this method of draining the pelvis the time of convalescence of the patient is not lengthened beyond that of cases where drainage is not required.

## COMPLETE HYSTERECTOMY

Except for malignant disease, complete hysterectomy, which implies an extirpation of the cervix together with the uterine body, is seldom necessary. There are, however, certain conditions which make the removal of the cervix desirable, conditions that sometimes cannot be foreseen before the abdomen is

opened for operation. On account of the possibility of indication for complete hysterectomy, and consequent exposure of the vaginal mucous membrane, the vagina should always be thoroughly prepared before a pelvic operation which by any chance may involve a hysterectomy.

One of the conditions that make a removal of the cervix advisable is a chronic endocervicitis associated with pelvic inflammatory disease. In most

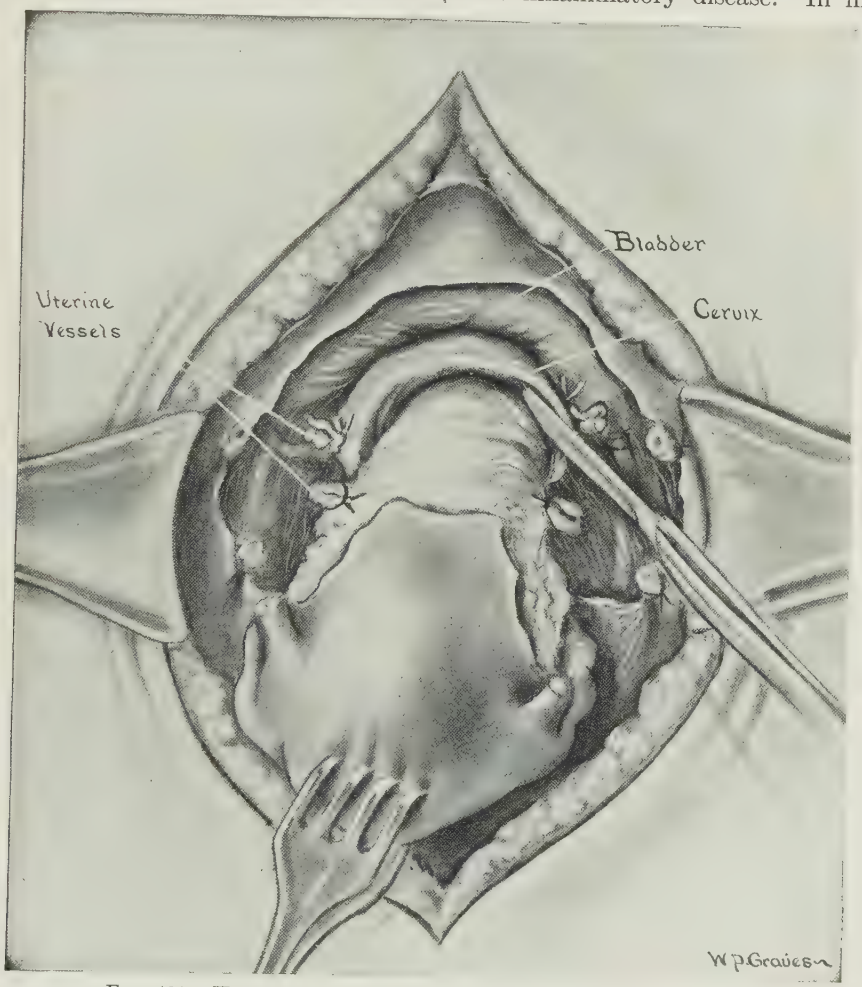


FIG. 429.—HYSTERECTOMY WITH REMOVAL OF THE CERVICAL CANAL.
The uterine vessels have been tied (or clamped) and cut. The cervical canal is being "coned" out with a knife.

cases such an endocervicitis heals spontaneously after a supravaginal hysterectomy, but occasionally the inflammation persists and the patient continues after the operation to suffer from an irritating leukorrhea. This unpleasant consequence may be avoided by a removal during the operation of the cervical mucous membrane, which can be accomplished either by performing a complete hysterectomy, as described below, or, better and more simply, by "coning"

out the cervical mucosa, as depicted in Fig. 429. This latter maneuver is especially valuable in pelvic inflammatory cases in which there has been parametritic infiltration, making the complete removal of the cervix a difficult and dangerous procedure.

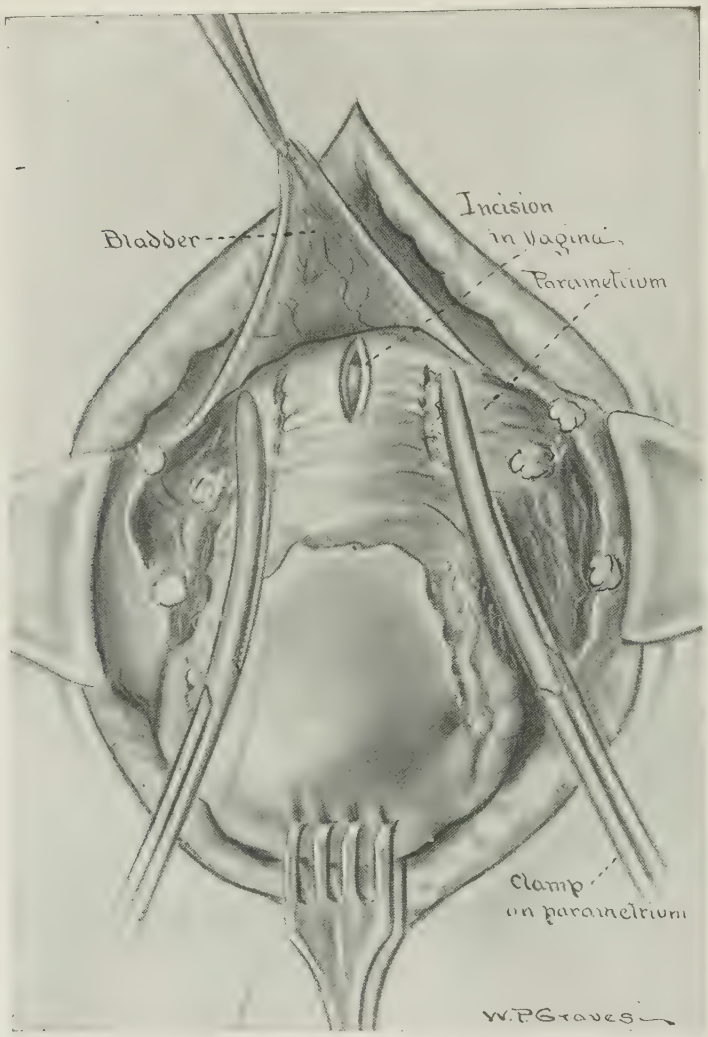


FIG. 430.—COMPLETE HYSTERECTOMY.

The vessels have been tied and cut and the bladder dissected from the anterior cervical wall. The parametrium is grasped on each side with pressure forceps and divided close to the cervix and vagina. A small longitudinal incision has been made exposing the vaginal portion of the cervix. The vagina is divided in a circular direction, starting from the small incision.

The operation of coning the cervical mucosa is performed in the following way: All the preliminary steps of a supravaginal amputation are carried out as described above. Then, instead of amputating the uterine body in the usual way, it is dissected away by a deep circular incision in the tissues of the cervix extending to the portio, so that most of the cervix is removed with the

uterus in the form of a cone-shaped wedge, including all of the cervical mucous membrane. By this method very little bleeding is encountered and there is absolutely no danger of injuring the ureters. As only a minimum of vaginal surface is exposed, the wound in the cervix may usually be closed as in an ordinary supravaginal hysterectomy without drainage, provided, of course, there has been proper preliminary preparation of the vagina. If it seems de-

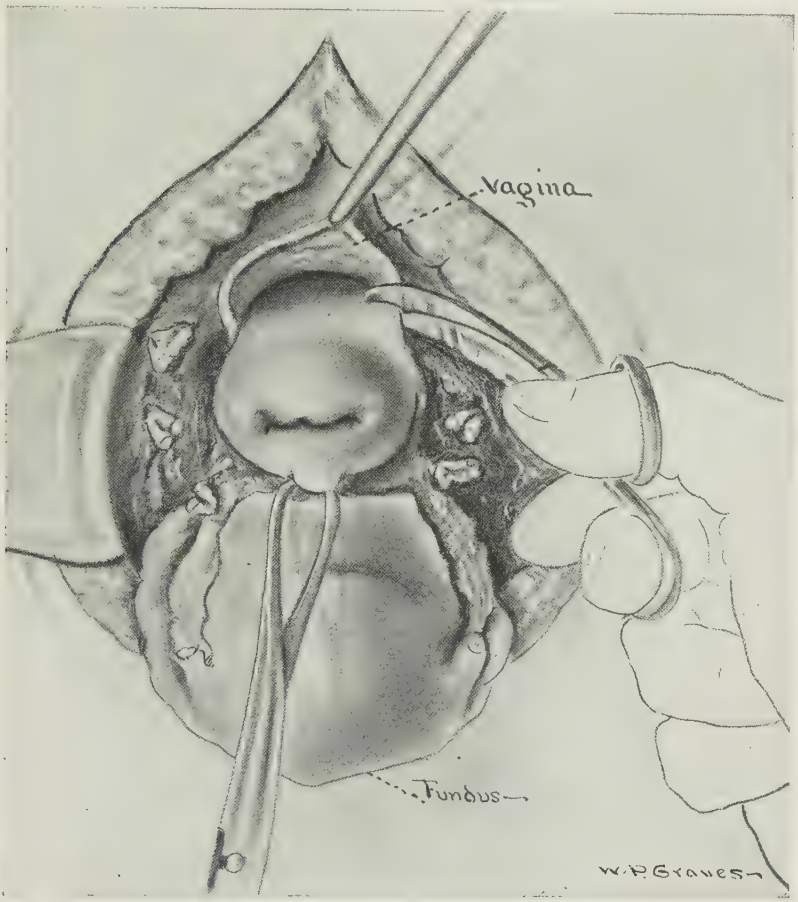


FIG. 431.—COMPLETE HYSTERECTOMY.
The cervix has been grasped by the anterior wall and delivered through the opening in the vagina. The posterior wall of the vagina is about to be severed with scissors.

sirable to drain, it may be done as in the operation for complete hysterectomy described below.

Complete hysterectomy is indicated in certain cases of myoma involving the cervix, or when a severe laceration of the cervix is present, or when the gross appearance of the fundus suggests the presence of adenocarcinoma. Some cases of malignant disease of the ovaries or of extensively adherent intraligamentary cysts require complete hysterectomy.

**The Steps of the Operation.**—The adnexa and uterine vessels are secured and ligated as in the operation of supravaginal hysterectomy. The uterovesical plica of peritoneum is divided, and the bladder stripped away from the cervix and upper vagina by blunt scissors dissection. The parametrial tissue is then clamped very close to the cervix, extreme care being taken not to include the ureters, which should, if possible, be definitely located before applying the clamps. The parametrial tissue is divided on each side. The end of the cervix is determined by palpation with the thumb and forefinger, the vaginal canal opened close to the portio, and the uterus removed by circular incision of the vaginal wall. Crossen's technic of this part of the operation is shown in Fig. 430.

If the vagina has been carefully prepared beforehand, and there is no exudation from the uterine canal during the operation, it is sometimes safe enough to close the vaginal wound without drainage. As a rule, however, it is advisable to place a drain subperitoneally as follows: The edges of the vaginal wound are carefully wiped with alcohol. If by some error there has been no previous vaginal preparation, the upper exposed part of the vagina should be treated with iodin after first thoroughly protecting with gauze the surrounding parts of the pelvis. The corners of the vaginal wound are closed with interrupted catgut sutures, leaving a central aperture through which a cigarette-drain is placed. The broad ligaments are then sewed to the angles of the vaginal stump, while the uterovesical flap of peritoneum is drawn over the whole and stitched to the back of the vagina in the pouch of Douglas. In this way protective drainage is secured, while the vagina is suspended by the broad ligaments for the prevention of a later prolapse. The vaginal drain may usually be removed in thirty-six to forty-eight hours unless there is special danger of sepsis, in which case it is left in according to the exigencies of the case.

After finishing the portion of the operation involving the closure of the vaginal wound it is advisable for the surgeon to change gloves and instruments after removing the gauze placed for protection of the pelvis.

## VAGINAL HYSTERECTOMY

As compared with a properly executed abdominal hysterectomy, the extirpation of the uterus per vaginam has no advantages. It cannot be done more rapidly, and there is no less shock or loss of blood, though claims to the contrary are sometimes made. Vaginal hysterectomy is useful in some types of operation for procidentia.

**Steps of the Operation.**—The cervix is grasped by a traction forceps and drawn firmly down toward the introitus. A cross-incision is made at the line of junction of the bladder and anterior cervical wall. The bladder is then stripped from the cervix and the uterovesical pouch opened. The traction forceps is removed from the cervix, and the cervix is itself pushed back in the

vagina, so as to antevert the uterus. The fundus is thus brought into view, seized with volsella, and brought out through the opening in the uterovesical

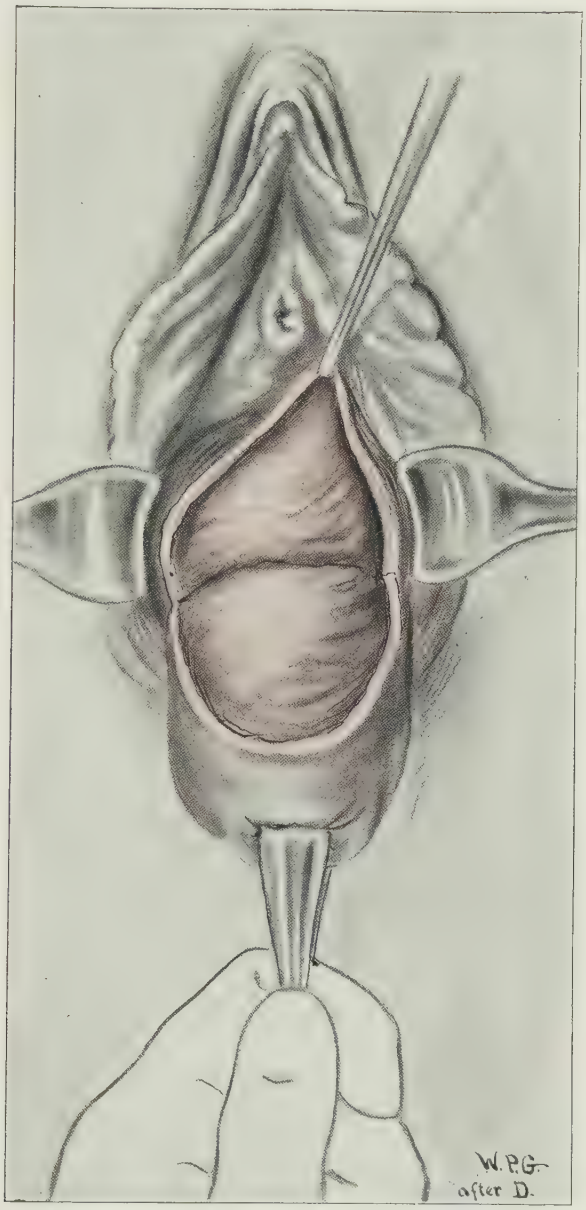


FIG. 432.—VAGINAL HYSTERECTOMY.
Transverse incision of the vaginal wall at the junction of bladder and cervix. Stripping back the bladder (adapted from Döderlein-Krönig).

pouch. Mass ligatures are now placed on the broad ligament, including the round ligament tube and suspensory ligament of the ovary, which are severed near the uterus. The parametrium is divided on the sides of the

uterus, thus exposing the uterine vessels, which are tied and cut. Several stitches are placed in the stump of the parametrium on each side, attaching it to the sides of the vaginal wound. The uterus is now drawn strongly forward and the pouch of Douglas exposed. With the uterus in this position the posterior wall of the vagina is easily divided. During this incision there is

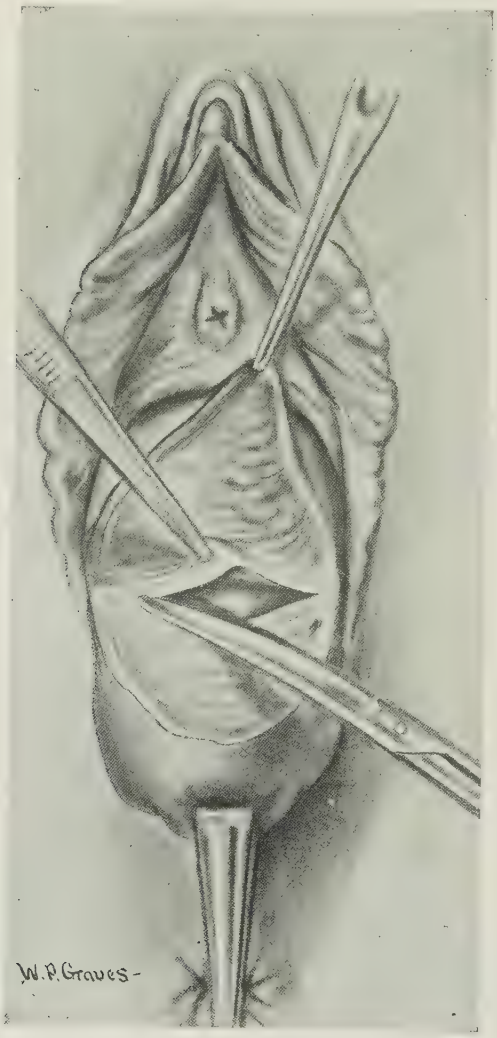


Fig. 433.—Vaginal Hysterectomy.
Opening the uterovesical space (after Döderlein-Krönig).

some bleeding from the vaginal vessels, which should be controlled as the uterus is removed. The round ligaments are then sewed into the corners of the vaginal wound. This is an important step, for it prevents to some extent a later prolapse of the vaginal wall. The anterior and posterior vaginal walls are approximated by interrupted catgut sutures.

## WERTHEIM'S EXTENDED OPERATION FOR CANCER OF THE UTERUS

The Wertheim operation is used both for cancer of the cervix and cancer of the body of the uterus. Its chief object is to remove with the uterus as much of the parametrial tissue as possible and to include a wide margin of the vagina.

The description of the operation given below applies to cancer of the cervix. For cancer of the body the same technic may be applied, but the dissection of the parametrium and the vaginal margin need not be so extensive.

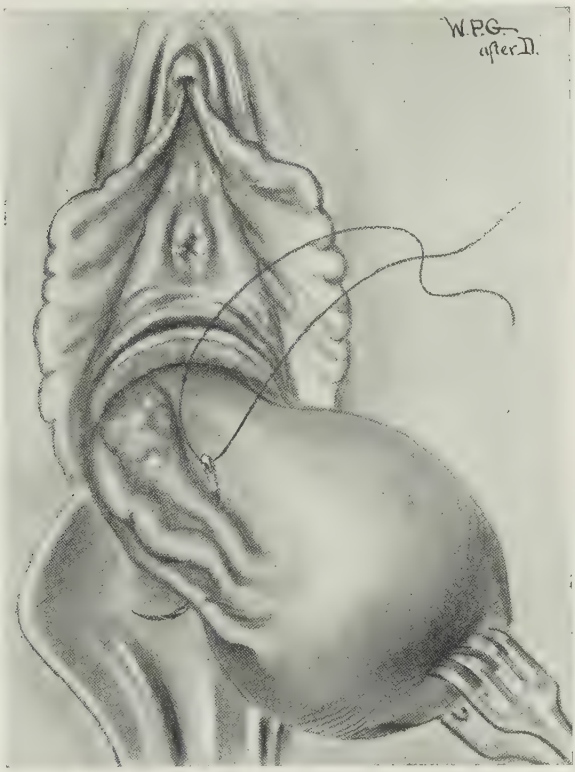


FIG. 434.—VAGINAL HYSTERECTOMY.
Tying off the adnexa.

Before operating on a case of cancer of the cervix, especially of the everting type, it is usually necessary to remove the necrotic excrescent growth from the vagina. By the original Wertheim method this is done without anesthesia immediately before the performance of the radical operation. Some curet the cervix just before, with the patient under anesthesia. It is our custom to do the preliminary curcting under light narcosis about a week or ten days before attempting the main operation.

In performing the preliminary operation the chief object is to remove merely the main bulk of the cancerous mass in order to facilitate the later operation, and to leave the cancerous field so that it can be made as clean as possible

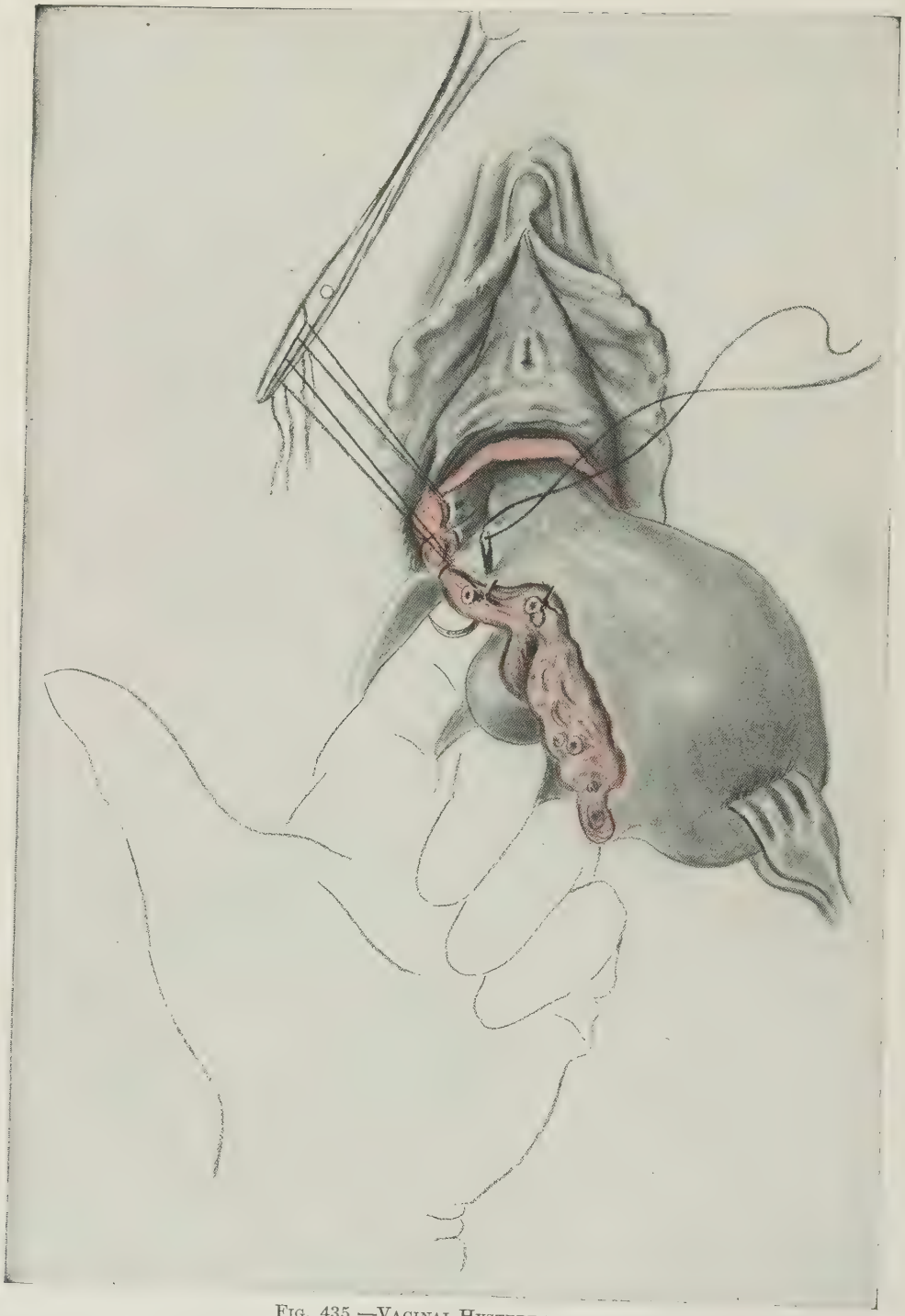

FIG. 435.—VAGINAL HYSTERECTOMY.

The broad ligament and the upper part of the parametrium have been divided. The under part of the parametrium and posterior vaginal wall are about to be divided (adapted from Döderlein-Krönig).

during the days intervening before the radical operation. The cancerous masses are removed with a large curet, but the curet is not carried too deeply

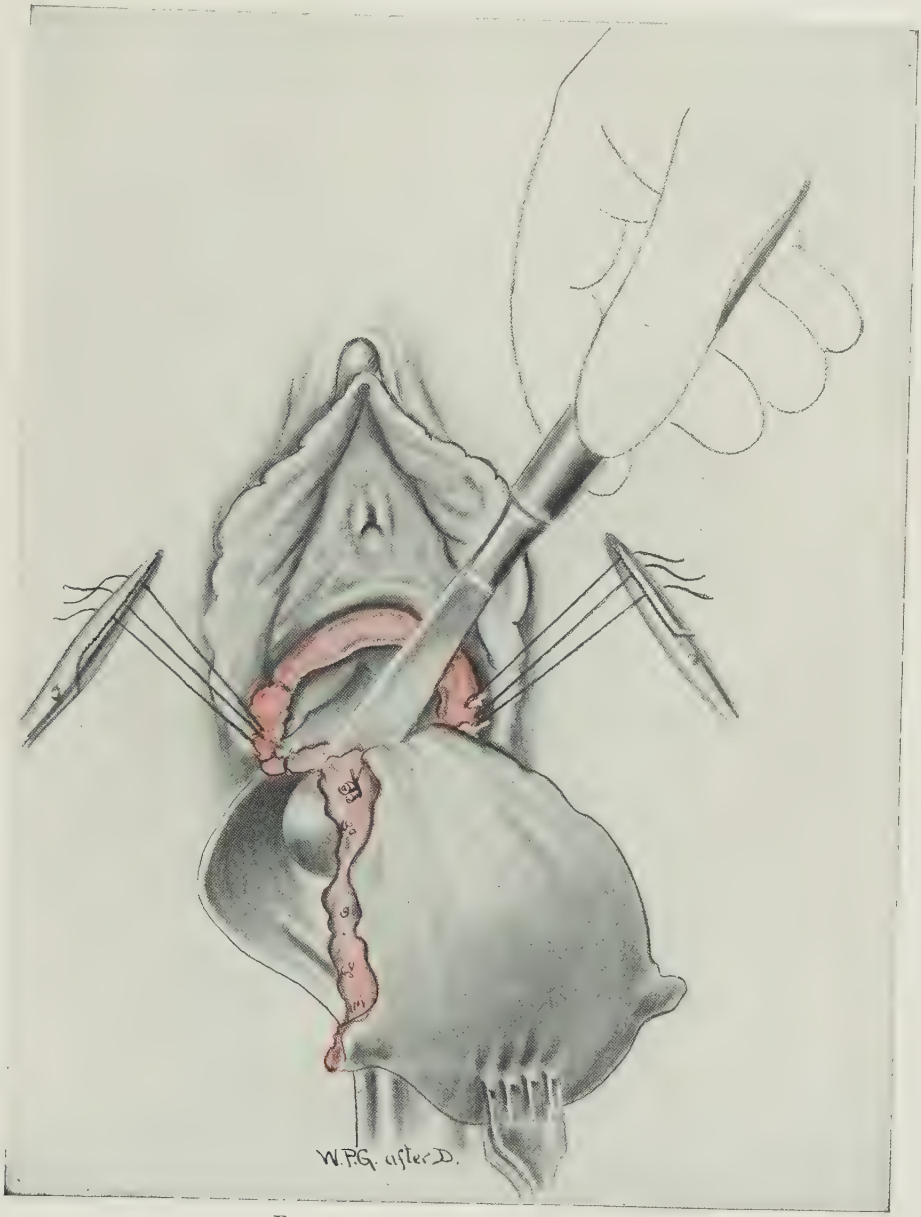

FIG. 436.—VAGINAL HYSTERECTOMY.
Division of the posterior vaginal wall (adapted from Döderlein-Krönig)

into the surrounding tissue wall, for if this is made too thin it is liable to be ruptured by the tension on the uterus necessary in the course of the later operation. Another important reason for a not too thorough cureting is the possible danger

of penetrating the peritoneal cavity, an accident which, on account of the virulent organisms always contained in the cancerous mass, is almost inevitably followed by a fatal peritonitis.

The preliminary operation should be regarded also as a cureting and not as a cauterization, for if the latter is done a slough is produced, which during its separation produces an unclean discharge, that acts as a source of danger during the later operation. After cureting away the cancerous masses the

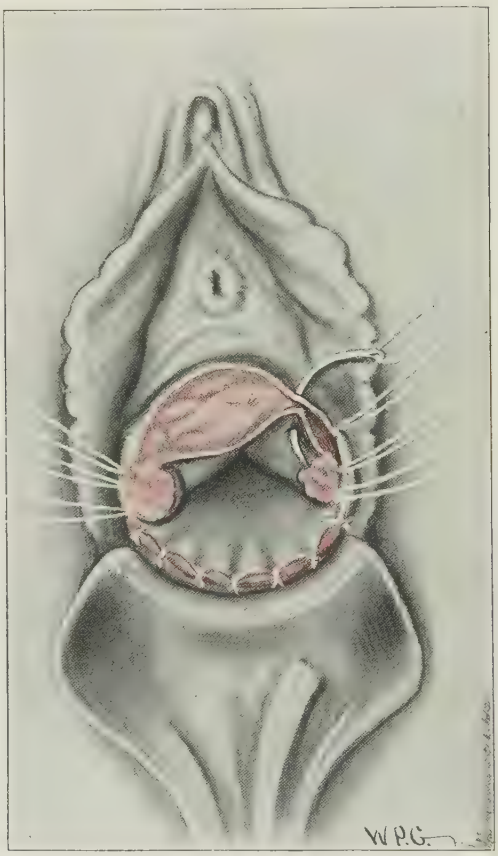


Fig. 437.—Vaginal Hysterectomy.
Sewing the peritoneum to the vaginal stump. The broad ligaments have been stitched to the vagina on each side (adapted from Döderlein-Krönig).

crater is packed with iodoform gauze to prevent unnecessary loss of blood. If the bleeding is considerable the vagina should also be packed. In about twenty-four hours the packing is removed. During the interval before the main operation formalin douches (1 to 2 per cent.) are given daily. The patient is kept out of doors as much as possible and supporting treatment given for about a week or ten days.

**The Operation.**—A thorough bowel preparation is very necessary, so that the intestines may be well collapsed at the time of operation. The catharsis

should be given the second night before the operation, so that the patient may have an undisturbed night preceding the operation. The usual abdominal and vaginal preparation is carried out. When the patient has been anesthetized the vagina is wiped dry and then thoroughly painted with iodin. It is not necessary to leave a gauze packing in the vagina if the iodin application is properly done.

In performing the operation it is important to carry out a very systematic line of procedure in order to save as much time as possible.

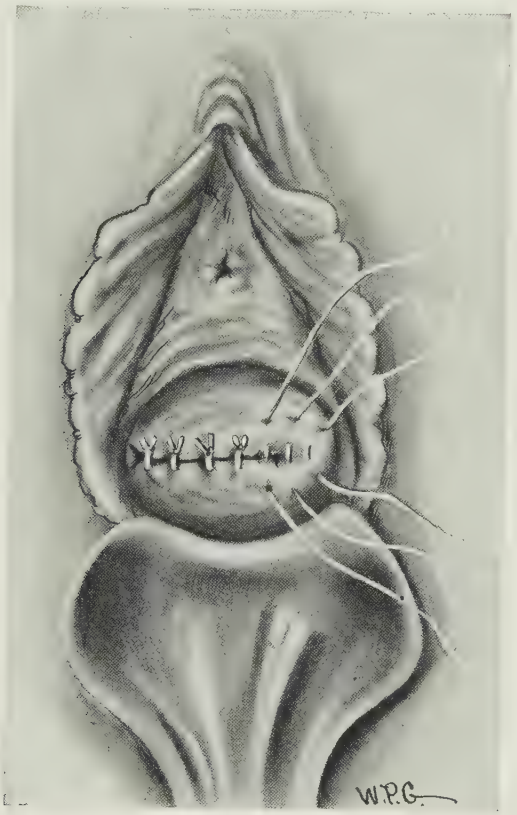


FIG. 438.—VAGINAL HYSTERECTOMY. FINAL STEP.
Suturing the anterior and posterior walls of the vagina.

(1) *Opening the Abdominal Cavity.*—It is advantageous to have the patient in a steep Trendelenburg position, which in our experience does not possess the dangers very commonly attributed to it. It is important that the weight of the patient should be partly supported by well-padded shoulder-braces. The abdomen may be opened by a very long median incision reaching from the pubes to the umbilicus. This is the incision usually employed in this country, and, as a rule, gives plenty of room. The transverse incision carried directly across the abdominal muscles, as depicted in Fig. 439. exposes the field of operation more completely than does the longitudinal opening. We have not found

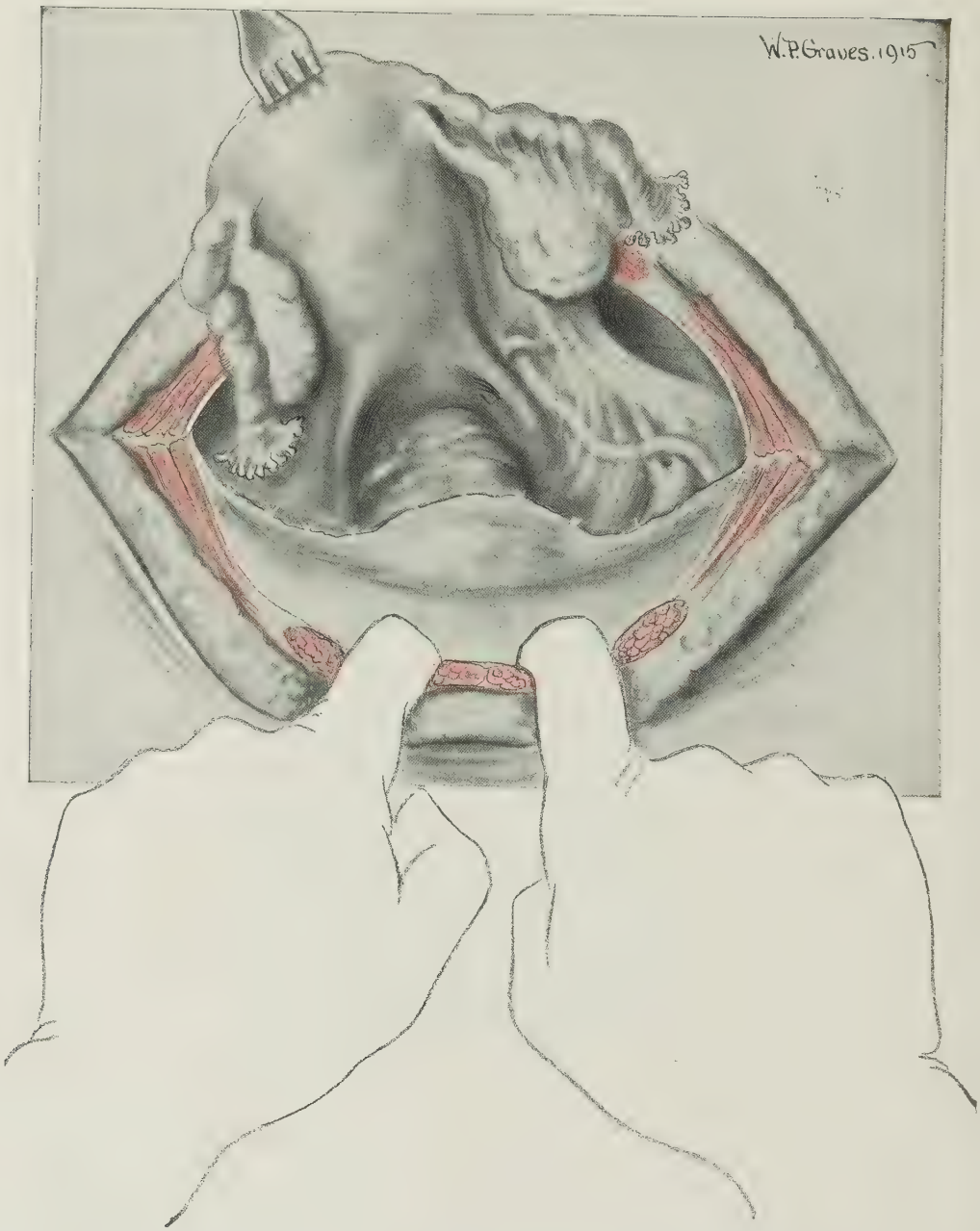


Fig. 439.—Transverse Incision for Cancer of the Cervix.

The abdominal muscles have been severed from spine to spine. The peritoneum has been split from the abdominal wall and stitched down so as to protect the intestines from the field of operation.

it necessary to resort to this method. In our work we have had no trouble with necrosis and sloughing of the abdominal wound from prolonged retraction pressure during the operations. This complication, however, is mentioned

by numerous operators, and various means of protecting the wound are employed, red sheet-rubber being especially recommended. Wertheim avoids the difficulty by not using metal retractors, the sides of the wound being held back by the hands of his assistant.

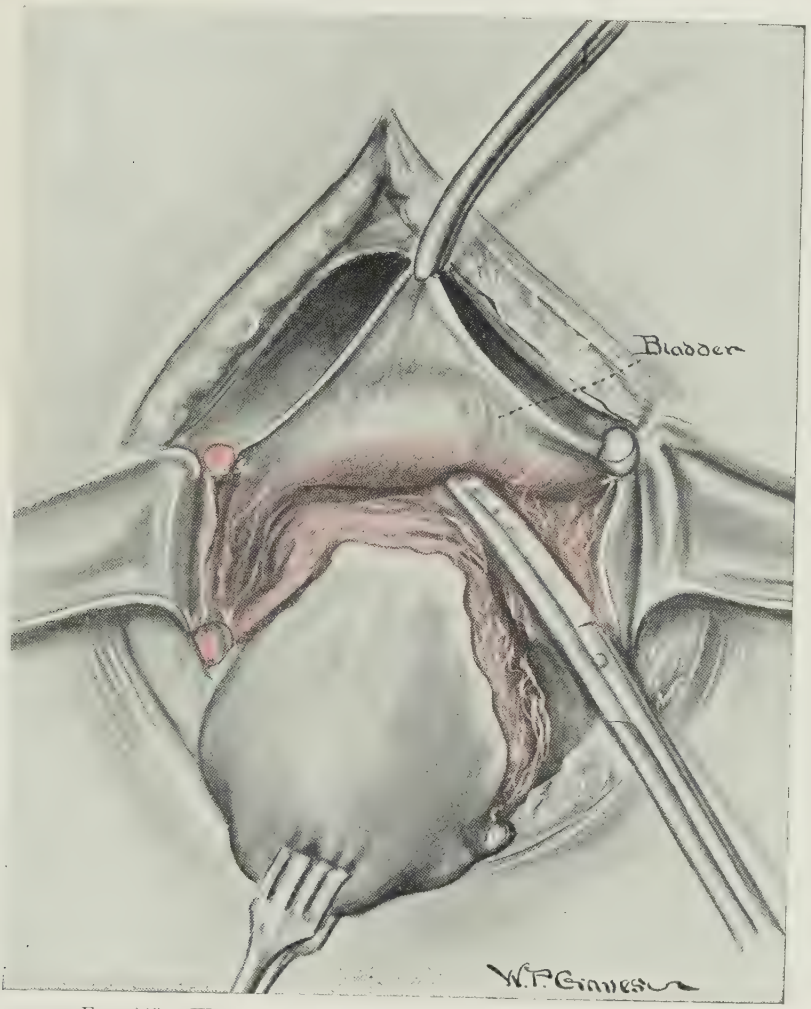


FIG. 440.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX.
Stripping the bladder from the anterior wall of the cervix and vagina. This should be done by blunt dissection with scissors, never with gauze.

Some protect the intestines by turning down a wide flap of peritoneum from the anterior abdominal wall and stitching it to the peritoneum of the posterior pelvic wall, as is seen in Fig. 439, This we have not found necessary.

(2) *Ligature of the Broad Ligaments.*—The broad ligaments are tied in the same manner as that described for supravaginal hysterectomy, except that if the operation is for cancer of the cervix the ligatures around the infundibulo-

pelvic and round ligaments are placed at a greater distance from the uterus. This is done in order to remove a large amount of parametrial tissue. If the operation is for cancer of the body, where the dissection does not need to be so wide, the two ligaments may be tied and severed near the uterus, as in supravaginal hysterectomy. They can then be used to sew into the angles of the vaginal stump in order to prevent a future prolapse of the vagina.

In cancer of the cervix operations, however, it is necessary to cut the ligaments so wide that they are not available for suspending the vagina.

(3) *Separating the Bladder.*—After the broad ligaments have been tied and cut, the bladder is separated from the anterior wall of the cervix and vagina. The uterovesical peritoneal reflection is first picked up with thumb forceps in the middle line at a point where it can be easily lifted away from the underlying tissues; a nick is made in the peritoneum, and the blunt end of a pair of scissors introduced beneath the peritoneum, stripping it up toward each round ligament. The peritoneum is cut across, exposing the fold of bladder that is attached to the cervix and vagina. The bladder is then *dissected* away from its uterine and vaginal attachments and not stripped off with gauze. The dissection is best carried out with blunt scissors, partly by blunt dissection and partly by cutting the firmer strands of tissue.

This manner of freeing the bladder we regard as of great importance in the technic, for the use of gauze dissection is a source of much danger to the bladder, not only in the way of actually rupturing the bladder wall, but in so traumatizing the small vessels of the wall as to result in later cystitis or ulceration (see also page 273).

The separation of the bladder should be carried down as far as possible; small bleeding vessels should be tied at once with fine catgut. A complete separation of the bladder cannot be made at this stage.

(4) *Identification of Ureters and Ligation of Uterine Vessels.*—When the bladder has been dissected away as far as possible, the uterus is held forward and to the left, exposing the right side of the pelvis. The next step is to identify clearly the right ureter. The two layers of the broad ligament are separated and the cellular tissue between them gently cleared with the blunt end of the scissors. In favorable cases the ureter is plainly seen lying at the base of the sulcus between the two layers of the broad ligament. Usually, however, it is not at first easily visible, and requires some search. It may best be found by picking up the posterior layer of the broad ligament and rolling the tissue between the thumb and forefinger, when it can usually be felt as a soft, non-pulsating cord. Some operators, after identifying the ureter, free it and lift it from its bed by passing under it a strip of gauze or a ligature or some curved instrument. We are accustomed to strip the ureter as little as possible, as interference with its blood-supply predisposes to necrosis and ureteral fistula. When the ureter has been isolated, the next step is to tie the uterine vessels. With the ureter as a guide, the forefinger is passed beneath the uterine vessels in the

direction of the bladder, and then pushed forward until it emerges through the cellular connective tissue lying between the uterine vessels and bladder (Fig. 442).

The first part of this maneuver is comparatively easy, but the final protrusion of the finger through the last layer of tissue is attended with considerable difficulty, and in cases of chronic parametritic inflammation, or especially after radium treatment, it is almost impossible. If the forefinger cannot be pushed

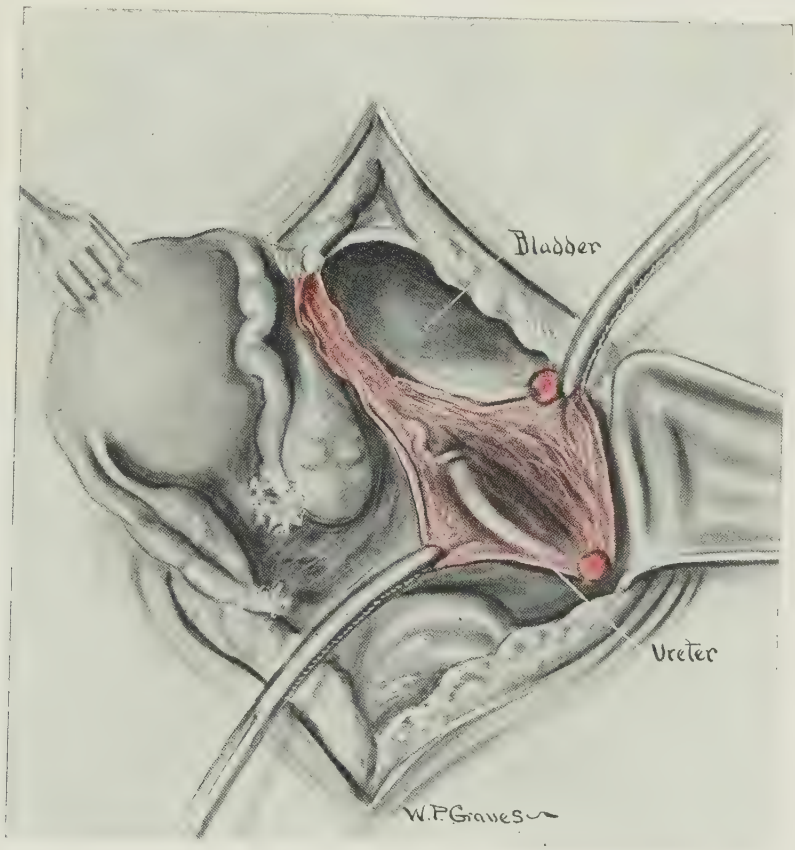


FIG. 441.—WERTHEIM'S OPERATION FOR CANCER OF CERVIX.

Exposure of the right ureter. The two leaves of the broad ligament are separated and the ureter brought into view by blunt dissection. It always lies in the posterior leaf and can easily be palpated by the thumb and forefinger.

through in the classic way the opening may be made by a blunt ligature-carrier or by a clamp devised by the author for this purpose and depicted in Fig. 444).

When the finger has been properly looped about the vessels the pulsation of the uterine artery can easily be felt. The vessels are then lifted away from the ureter and freed as far as possible toward the pelvic wall. A double ligature is passed and tied and the vessels cut between the two ligatures. The ureter and its point of entrance into the bladder are now freely exposed, and an oppor-

tunity given for separating by blunt dissection the ureter and angle of the bladder from the lateral wall of the vagina. This procedure helps to carry out still further step No. 3—*i. e.*, the separation of the bladder from the vagina, which it was said was necessarily left incomplete.

The isolation of the ureter, ligation of the uterine vessels, and separation of the ureter and bladder from the side of the vagina are repeated on the left side.

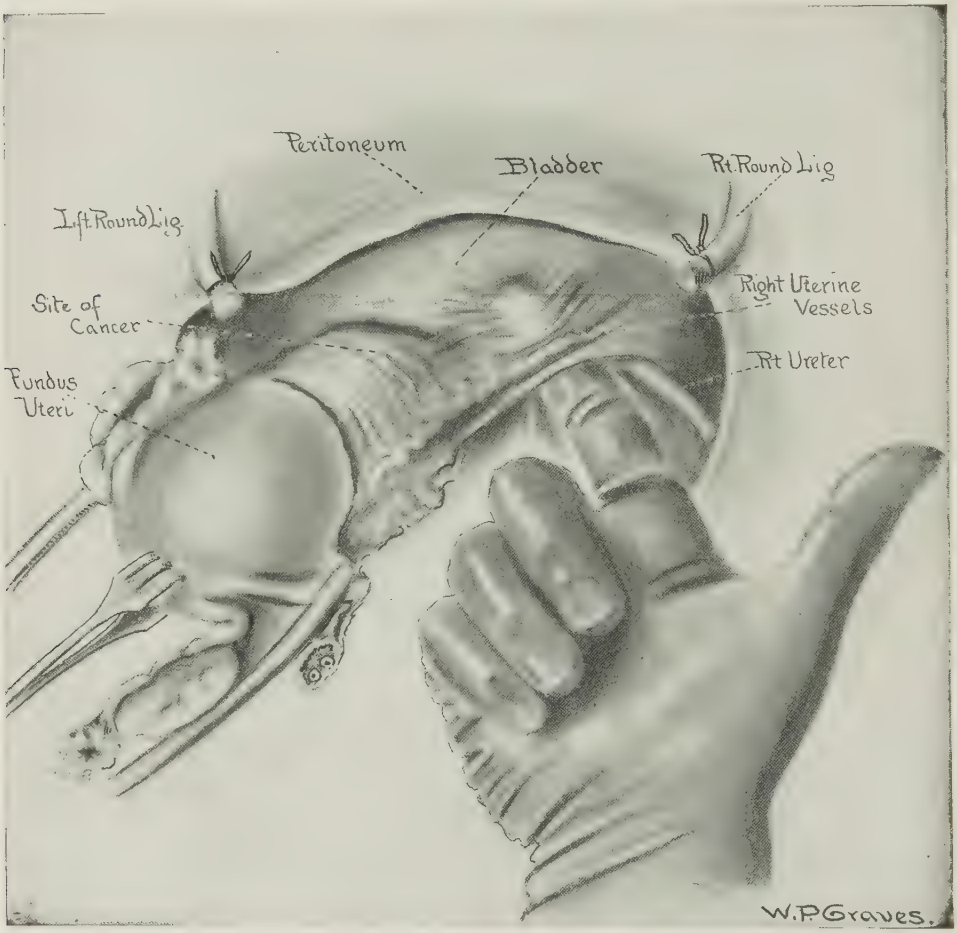


FIG. 442.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX.

The broad ligaments have been tied and cut. The bladder has been dissected from the cervix. The right ureter is exposed. The forefinger is being introduced between the ureter and uterine vessels. The point of the forefinger is forced through the cellular tissue in front of the vessels.

(5) *Separation of the Rectum and Final Dissection of the Parametrial and Paravaginal Tissue.*—The uterus is now drawn strongly forward, exposing as well as possible the pouch of Douglas. The peritoneum at the bottom of this pouch is picked up and cut, and the blunt-pointed scissors inserted beneath the peritoneum, as in separating the uterovesical reflection. The peritoneum is in the same way cut across from broad ligament to broad ligament, exposing the

uterosacral ligaments. Clamps are placed on the ligaments and the tissue severed. On cutting these ligaments the uterus is noticeably released. The rectum is, as a rule, easily separated from the vagina, as there exists between them only a loose cellular tissue connection.

After freeing the rectum, the remaining parametrial and paravaginal attachments on the sides and back of the vagina are successively clamped and cut.

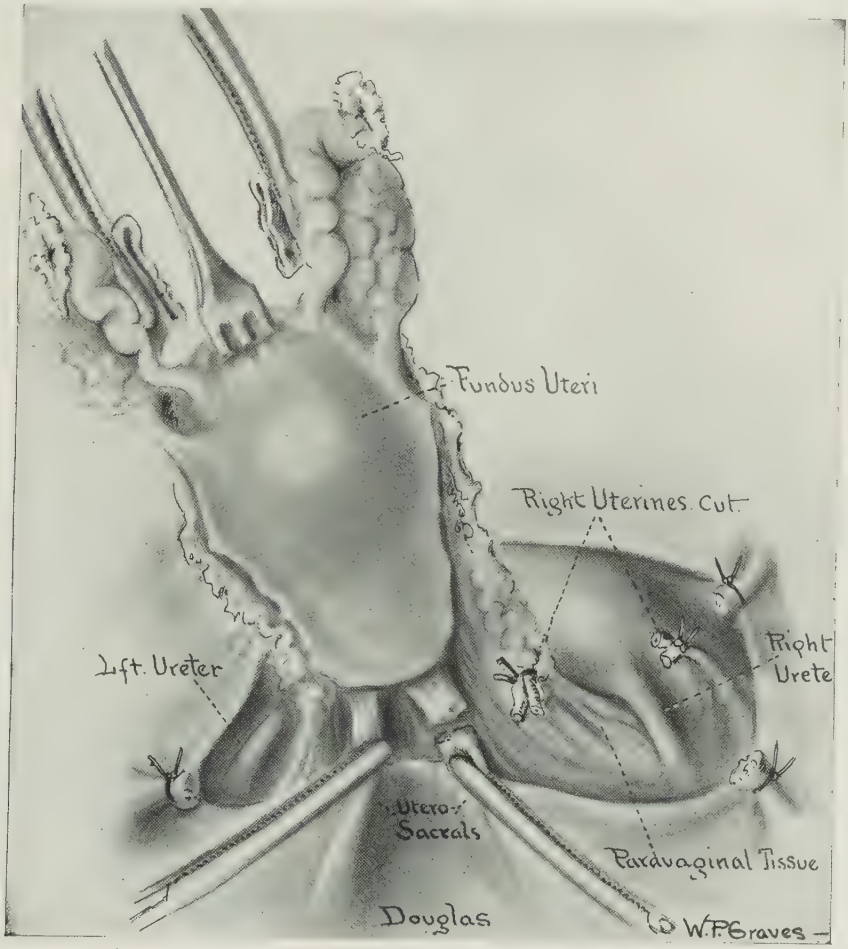


FIG. 443.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX.

The uterine vessels of both sides have been ligated and tied and the ureters exposed. The recto-uterine reflection of peritoneum has been divided. The uterosacral ligaments have been clamped and are being severed. The paravaginal tissue is exposed.

the uterine mass being more and more released at each cut. At this stage, before finally clamping and removing the mass, the bladder, especially at the points of entrance of the ureters, can be still further separated from the vagina.

(6) *Clamping and Amputation of the Vagina.*—When the dissection has been carried down the vagina as far as possible, always to a considerable distance below the site of the cancer, the vagina is to be amputated. It is an excellent

safeguard at this point to insert on each side of the vagina, just below the level of the proposed line of amputation, strong catgut ligatures, the ends of which are left long and clamped. These ligatures serve as tractors to prevent the

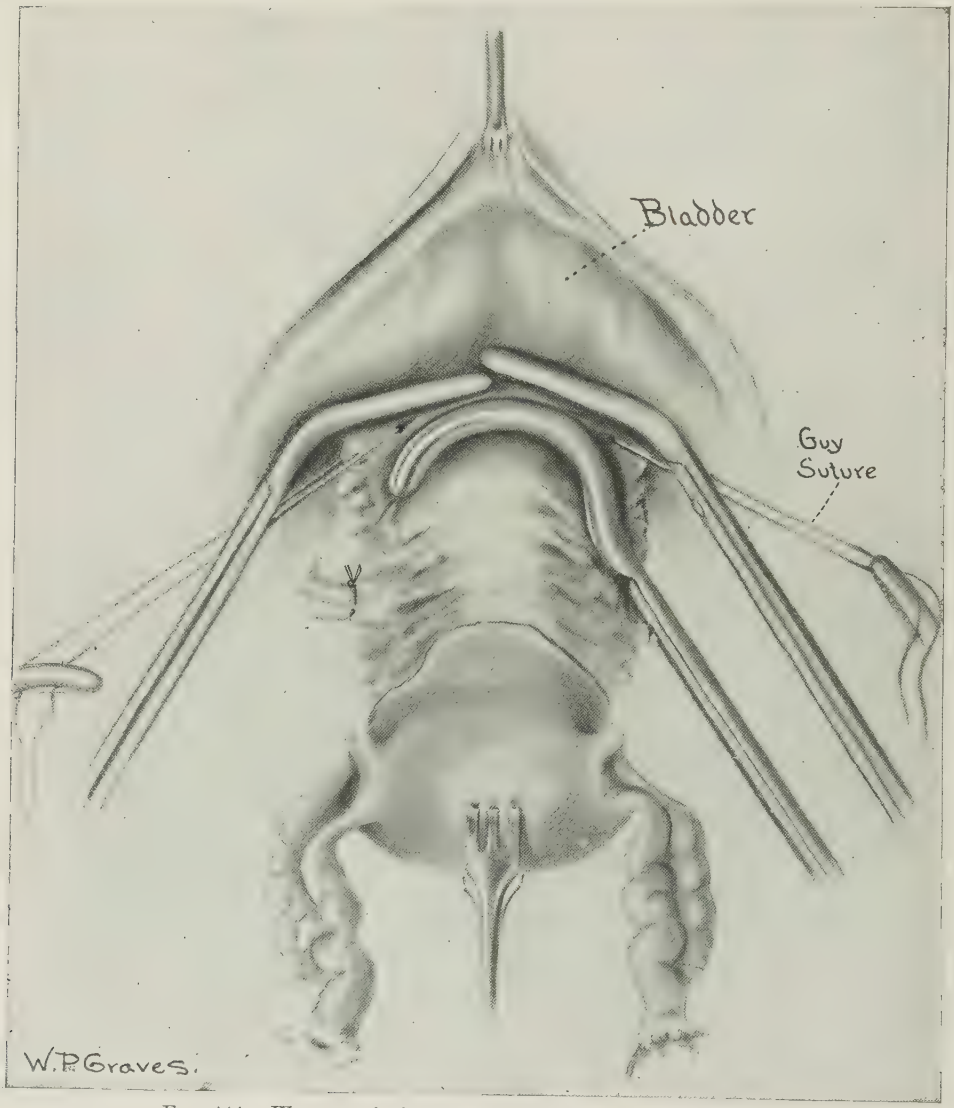


FIG. 444.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX.

The uterus and vagina have been freed. Traction sutures have been applied to the vaginal wall to hold it into view after amputation. The author's special clamp has been applied to the vagina below the seat of the growth. Wertheim clamps have been applied below. These latter may be omitted if there is deficient vaginal margin. Amputation is made between the clamps with knife or cautery.

retraction of the vaginal stump after amputation, and also to control the bleeding which is apt to come from the vaginal angles.

In order to prevent the escape from the cancerous field of possible infectious

material the vagina must be effectively shut off for its entire width. To accomplish this numerous clamps have been devised, notably the right-angled clamps of Wertheim. Berkeley and Bonney use a large T-clamp, which appears to be an excellent device. In the drawing (Fig. 444) the vagina is clamped above and below, the amputation being made between the clamps. This has been the author's technic, but with a thorough vaginal preparation, such as is described above, it is probably better to dispense with the lower set of clamps, as without them more of the vagina can be removed. Their presence, however, insures for

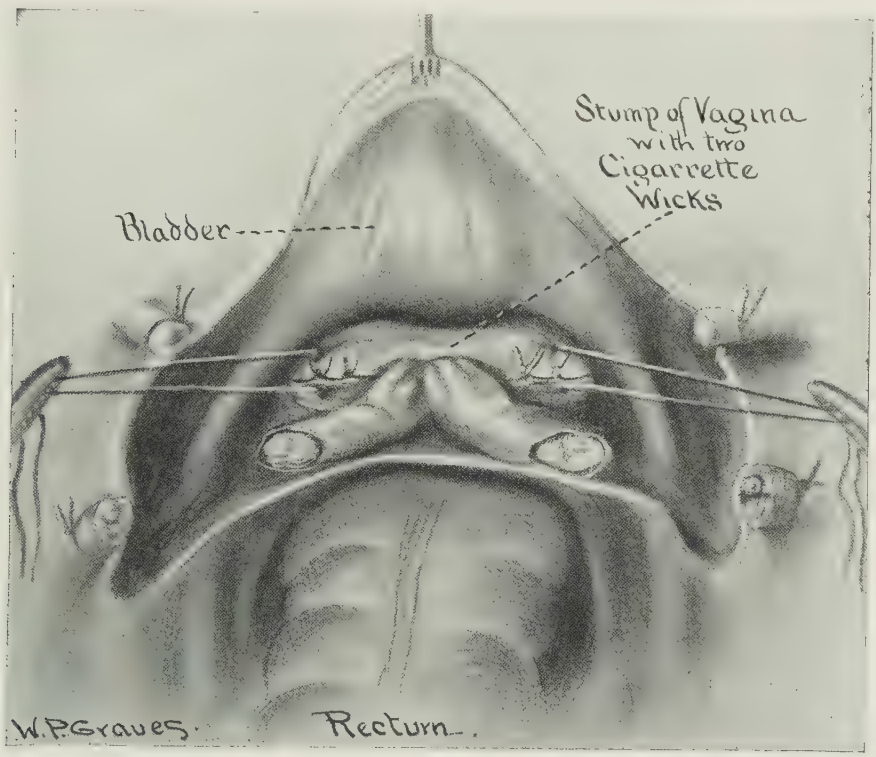


FIG. 445.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX.

Two cigarette wicks have been placed in the opening of the vagina. The vaginal walls, held up into view by traction ligatures, have been sutured on each side of the wicks. The peritoneal edges are to be stitched together over the wicks, thus shutting them off from the peritoneal cavity.

safety both in controlling hemorrhage from the vaginal veins and in preventing possible infectious material escaping from the lower vaginal section into the abdominal cavity. If the lower clamps are not used, gauze should be stuffed into the vagina as soon as it is opened.

After amputation of the vagina ligatures are passed around the masses of paravaginal tissue included in the clamps. The vagina is partially closed by interrupted sutures, a small opening being left in the middle.

(7) *Drainage and Closure of the Peritoneum.*—It is the safest plan to drain the paravaginal space. This is done by passing into the vaginal opening a loop

of Penrose drainage-tubing, which is caught and drawn down by an assistant, who seizes it with a long forceps inserted in the vagina from below. This leaves the two ends of the drainage-tube free in the abdominal cavity. The peritoneum is united *over* the drain, so that it is excluded from the peritoneal cavity.

(8) *Removal of Glands.*—If infected lymph-glands are found to be present, it is our custom to finish the main operation up to the point of closing in the peritoneum before dissecting out the glands, in order to be ready to finish the operation quickly if the patient begins to show signs of shock or if serious difficulty is encountered in dissecting out the glands. The removal of the glands requires patience and skill on the part of the operator.

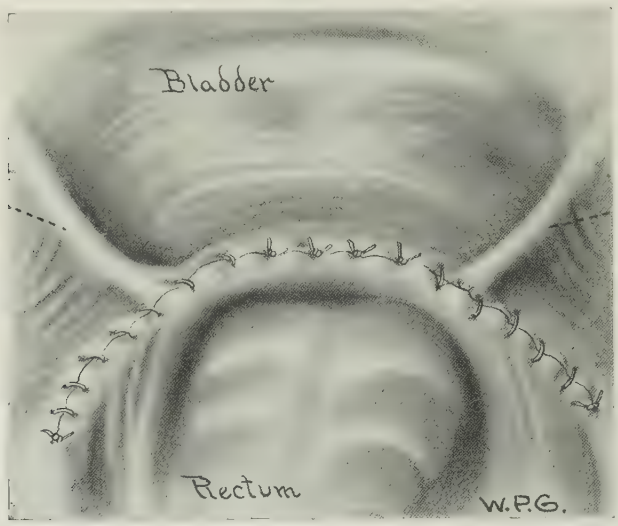


FIG. 446.—WERTHEIM'S OPERATION FOR CANCER OF THE CERVIX. Final Step. The peritoneum has been completely sutured over the rubber drains. Note that the four middle sutures are interrupted.

Shock depends almost exclusively on the loss of blood. In the average case where the hemorrhage has not been severe, there is no shock and the convalescence is rapid.

Complications that may be met with during the operation are injury to the bladder, ureter, or rectum, and dangerous uncontrolled hemorrhages. The last are most apt to be encountered in cases where there has been a long-standing pelvic inflammatory disease with peritoneal adhesions. In these cases the landmarks become confused and the usual planes of cleavage between tissues are lost. The same is true in operating on cases that have been treated by radium.

## EXTENDED VAGINAL HYSTERECTOMY FOR CANCER OF THE CERVIX

The operation developed by Schauta is a very difficult one, and should be attempted only by those familiar with the vaginal route for performing pelvic surgery. The illustrations of this operation are adapted from Schauta.

The cancerous area is first thoroughly cureted and cauterized. The operation is then performed by the following steps:

(1) *Circumcision of the Lower End of the Vagina.*—A circular incision is made around the circumference of the vagina at the introitus, and the vaginal wall dissected away for the distance of about 2 inches. In this way a cuff is formed the open end of which is closely sewed with interrupted sutures, the ends of which are left long and included in a clamp. The vaginal cuff is now

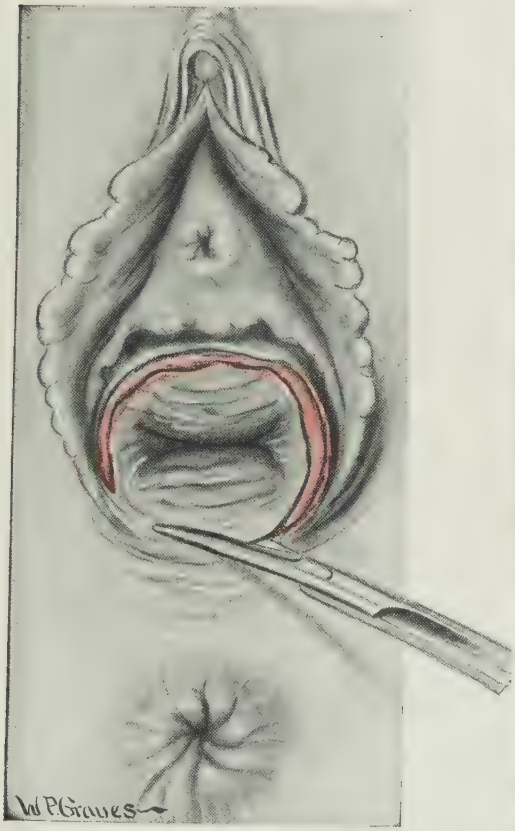


FIG. 447.—SCHAUTA'S OPERATION FOR CANCER OF THE CERVIX.
Initial circumcision of the vagina.

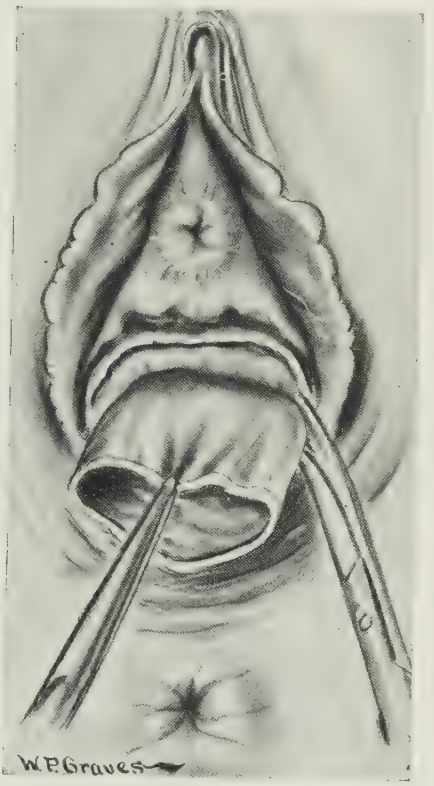


FIG. 448.—SCHAUTA'S OPERATION FOR CANCER OF THE CERVIX.
The vaginal cuff is being dissected.

held forward by the sutures, and the separation of the vagina continued along its lateral and posterior wall, care being taken not to injure the rectum. The dissection of the vagina from the rectum should be carried out with blunt scissors rather than by stripping with gauze.

(2) *Paravaginal Section.*—When the vagina has been well freed from the rectum a deep incision is made in the left lower angle of the vaginal bed, extending first laterally to the lower end of the left labium minus, then turning downward parallel to the rectum and to the left of it, separating the fibers of the

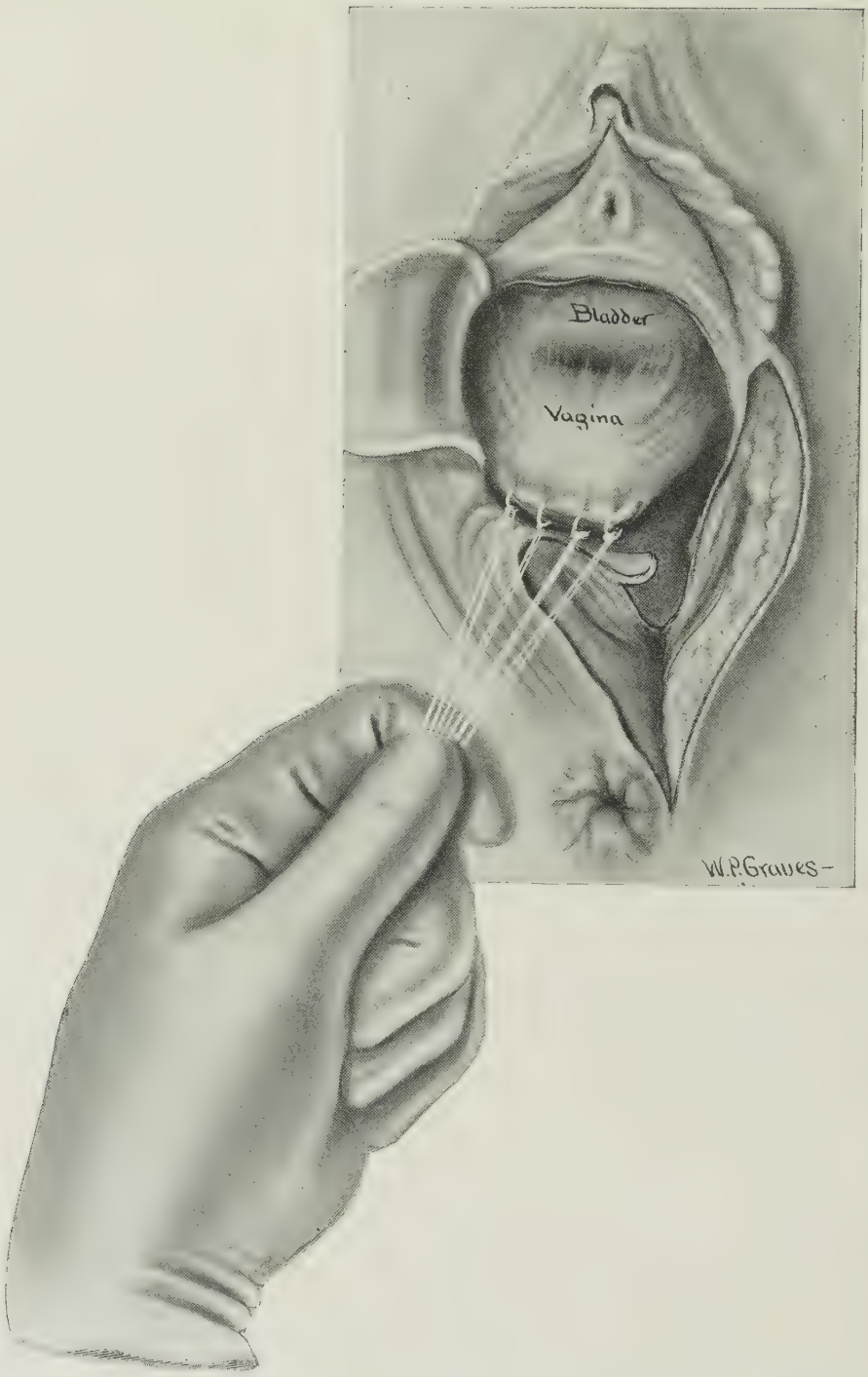


FIG. 449.—SCHAUTA'S OPERATION FOR CANCER OF THE CERVIX.
The vaginal cuff has been dissected out and closed with traction sutures. The bladder is exposed. The deep paravaginal incision has been made through the perineum.

levator ani muscle, curving around the anus, and terminating posterior to it, near the median line. Deeper in, the incision splits the paravaginal and pararectal tissues, the coccygeal muscles, and the cellular tissue of the ischiorectal fossa. Much bleeding is encountered, which can be controlled by ligature and gauze packing. By this incision a surprisingly large amount of room is afforded for carrying out the other steps of the operation. The tissue corresponding to

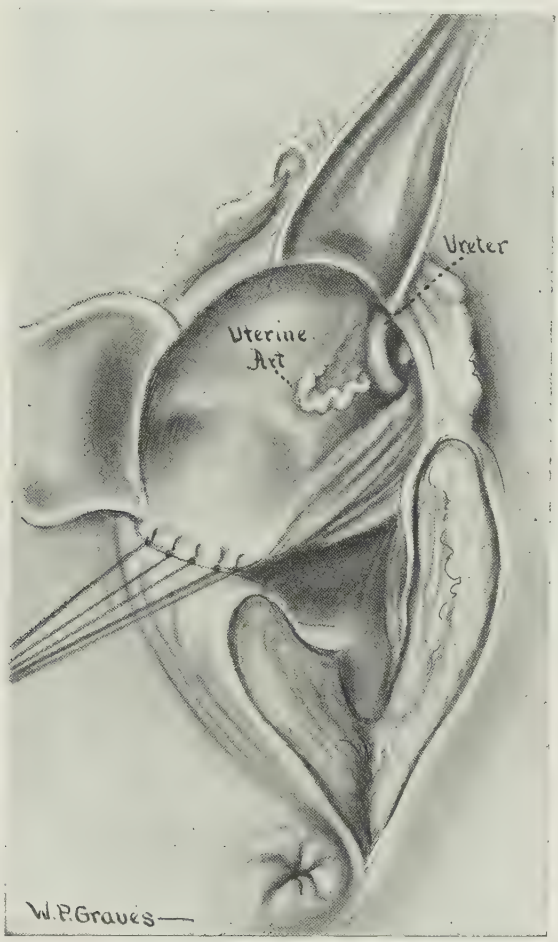


Fig. 450.—Schauta's Operation for Cancer of the Cervix.
The bladder has been separated from its vaginal and cervical attachments and held up by the upper retractor. The uterine artery, ureter, and parametrium of the left side are exposed.

Douglas' fossa is now picked up and cut and the recto-uterine pouch opened. A large strip of gauze is inserted into the pouch to prevent the prolapse of the bowels.

(3) *Separation of the Bladder and Identification of the Ureters.*—The vaginal wound is now held well back by the tension on the attached sutures, and the bladder dissected away from the vagina with blunt scissors. The dissection

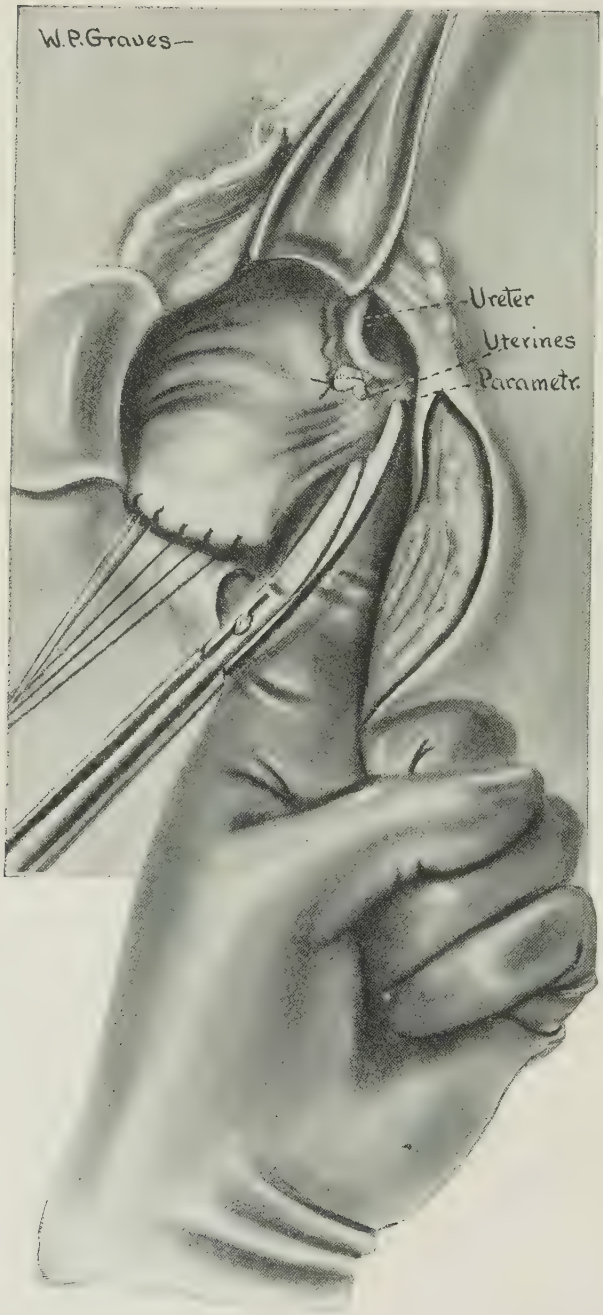


Fig. 451.—Schauta's Operation for Cancer of the Cervix.
The left uterines have been tied and cut. The ureter becomes freed. With the guidance of the left forefinger the parametrium is being divided.

should be carried well out on the sides of the vagina until the ureters are exposed. The bladder is now retracted upward and an opening made into the uterovesical pouch.

(4) *Ligature of the Uterines.*—The vagina is held sharply over to the right side, while the operator identifies the uterine artery with his left forefinger. A ligature-carrier is passed through the base of the broad ligament around the uterine vessels. The ligature is tied and the uterus cut from the part of the ligament secured by the tie. The vessels of the opposite side are tied in the same way.

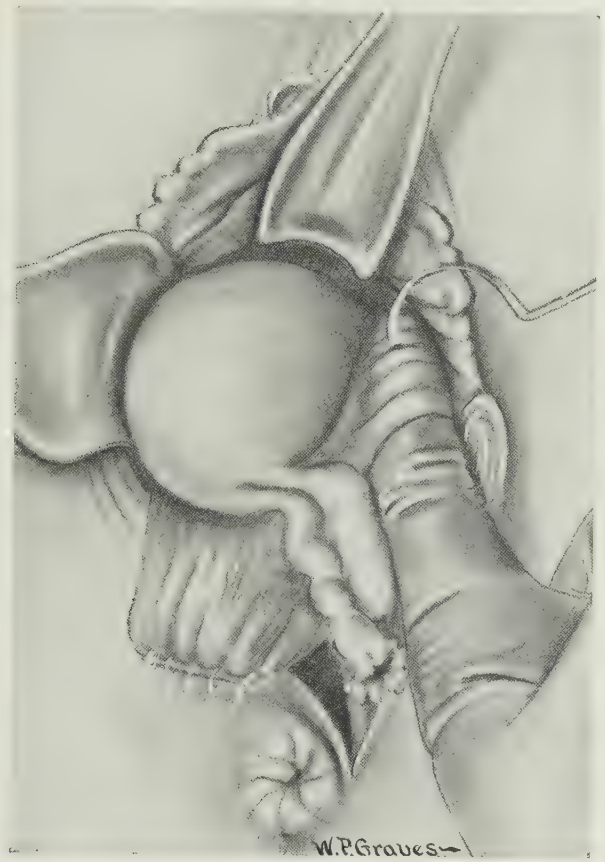


FIG. 452.—SCHAUTA'S OPERATION FOR CANCER OF THE CERVIX.
The fundus of the uterus has been delivered. The broad ligament of the left side is about to be tied and cut.

The parametrial tissue is excised as far away from the uterus as possible, there being some bleeding from the hemorrhoidal vessels that run to the uterosacral ligaments.

(5) *Removal of Uterus and Adnexa.*—The fundus of the uterus is delivered through the opening into the uterovesical pouch. This is accomplished by passing the forefinger of the left hand into the pouch of Douglas and anteflexing the fundus by pressure from behind. The fundus is seized with strong volsella and drawn sharply forward. In this way the broad ligaments are brought into view. The uterus is then drawn to the right and with

the left forefinger as a guide a double ligature is applied on a ligature-carrier to the broad ligament. The round and infundibulopelvic ligaments are tied and the uterus severed from the broad ligament. The same procedure is carried out on the opposite side and the uterine mass removed.

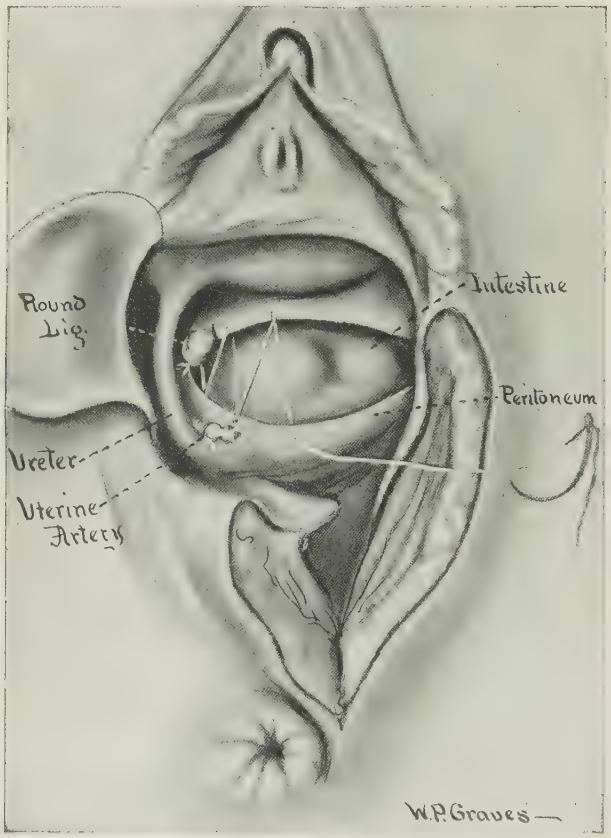


Fig. 453.—Schauta's Operation For Cancer of the Cervix. Closing the peritoneal layer by a continuous stitch.

The paravaginal wound is closed with deep sutures. The peritoneum is closed and a gauze packing left in the opening above the vaginal wound.

The convalescence is a long one owing to the time taken for healing of the vaginal wound.

## MYOMECTOMY OPERATIONS

### ABDOMINAL MYOMECTOMY

In performing the operation for enucleation of uterine myomata the abdominal incision must be made sufficiently large to admit of convenient handling of the pelvic organs. The fundus of the uterus is seized with double hooks and drawn toward the abdominal wound into such a position as will expose best the myoma to be removed. It is often advantageous to insert a second pair of

double hooks into the uterine wall immediately below the lower pole of the tumor, traction on which lifts the uterus so that the field of operation is more in a horizontal plane. An incision through the wall of the uterus is made parallel with the axis of the uterus over the most prominent part of the tumor. The incision is carried down to the surface of the myoma, which can usually be

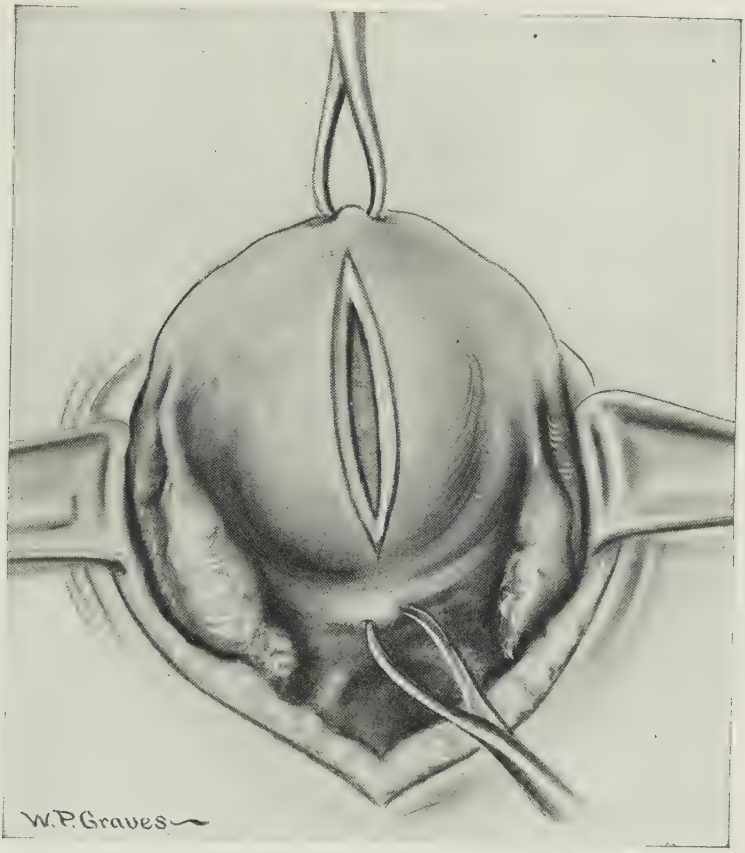


FIG. 454.—ABDOMINAL MYOMECTOMY.
Incision for a myoma in the posterior uterine wall.

recognized by the difference in direction of its fibers from those of the uterine wall. When the surface of the myoma has been exposed the tumor is grasped with a pair of double hooks carried deeply into the tissue. With firm traction on the double hooks the tumor can then be readily shelled out by means of some blunt dissecting instrument, a pair of blunt-tipped curved scissors being especially useful. The enucleation is done carefully to prevent too great laceration of the tissue of the uterine wall and to avoid, if possible, opening the uterine cavity.

If the tumor happens to be an adenomyoma it cannot be shelled out in this way, growing as it does diffusely in the wall of the uterus. Under these circumstances the tumor must be dissected away from the uterine tissue, from which it cannot always be clearly differentiated.

When the myoma has been removed, there is, except in the case of small tumors, considerable bleeding from the bed in which it lay. The careful control of this hemorrhage is of supreme importance, for it is to the lack of this precaution that the notoriously bad after-results of myomectomy are chiefly due. Bleeding points should be isolated and ligatured as far as possible, and

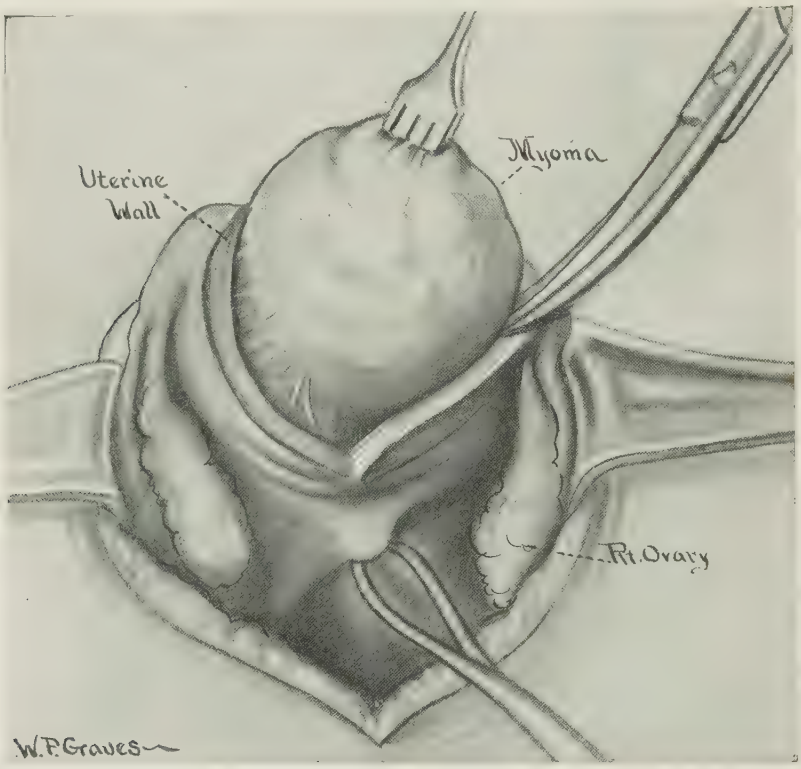


Fig. 455.—Abdominal Myomectomy.
The myoma is being shelled out from its bed by blunt dissection.

where this cannot be done, carefully placed mass sutures must be applied. Buried sutures are also used to close in the dead space left by the removal of the tumor, to avoid the retention of blood-clots in the uterine wall, and the peculiarly disturbing constitutional symptoms which the disintegration of the clots seems to produce. The peritoneum is closed by deep figure-of-8 catgut stitches (Fig. 456), this form of stitch being especially valuable both because of its broad approximation of tissues and because by its use fewer knots are exposed on the surface of the uterus.

The enucleation of large intramural myomata is a bloody operation, and results in great mutilation of the uterine body. It should not be undertaken excepting by an experienced surgeon. It should be borne in mind during an operation for myomectomy that too great tension in approximating the wound

edges of the uterine wall may result in a local necrosis that will seriously complicate the convalescence. Pedunculated myomata, on the other hand, even of very large size, may be removed without danger.

When it is necessary to remove a considerable number of small myomata it is important when possible to make incisions in the uterine wall in such a way that more than one tumor may be extracted through the same incision. This is advantageous because it makes fewer wounds in the uterine wall along which postoperative adhesions may form.

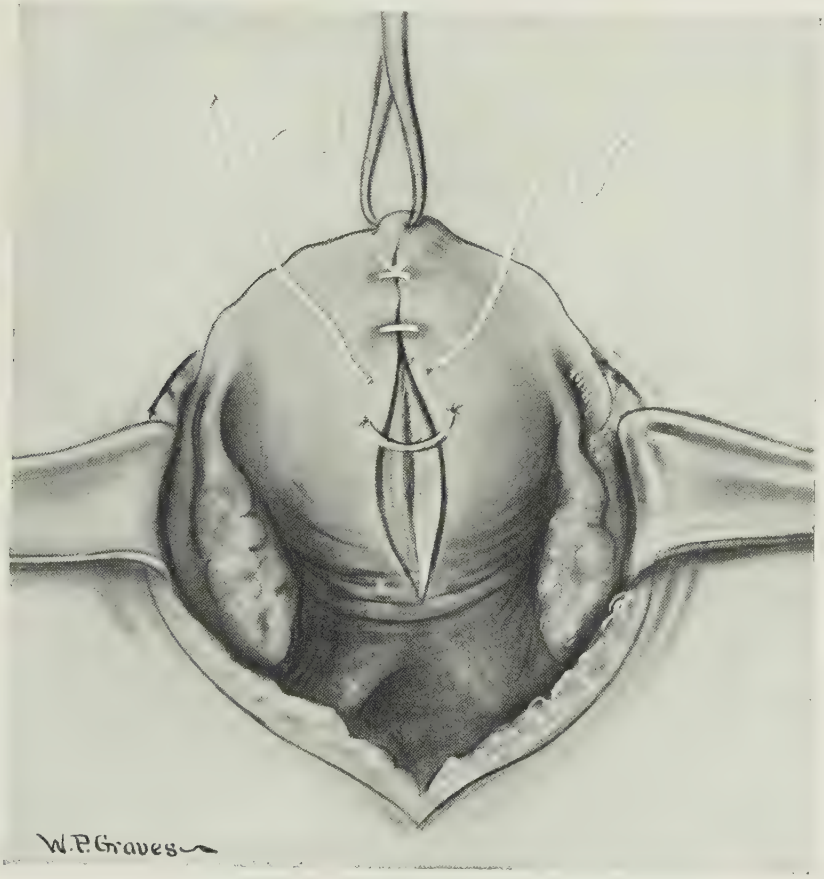


FIG. 456.—ABDOMINAL MYOMECTOMY.
The wound in the uterine wall is being closed with figure-of-8 sutures deeply placed.

After a myomectomy operation it is always advisable to suspend the uterus in some appropriate way in order to prevent the possibility of an adherent retroversion, a complication which otherwise is extremely likely to occur.

**Omental Grafting.**—After myomectomy operations involving the posterior wall of the uterus adhesions are extremely liable to form along the line or lines of incision. This complication may, to a certain extent, be prevented by attaching an omental graft to the uterine wall. The omentum is drawn out of the ab-

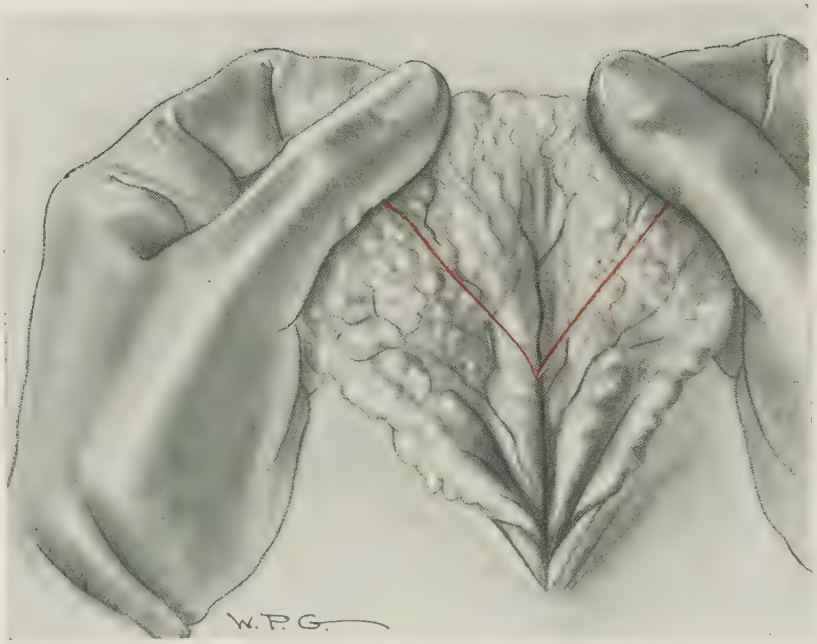


FIG. 457.—OMENTAL GRAFTING.
The omentum is lifted from the abdominal wound and a wedge-shaped section removed at a point where the omentum is plentifully supplied with blood-vessels.

FIG. 458.—OMENTAL GRAFT.
The trianguiar piece of omentum has been attached to the posterior wall of the uterus by several catgut sutures.

dominal wound and inspected as in Fig. 457. A portion having been selected which contains a good blood-supply, a wedge-shaped piece is exsected of a size

sufficient to cover the area on the surface of the uterus requiring protection. The cut edges of the omentum are sewed together after ligature of the bleeding

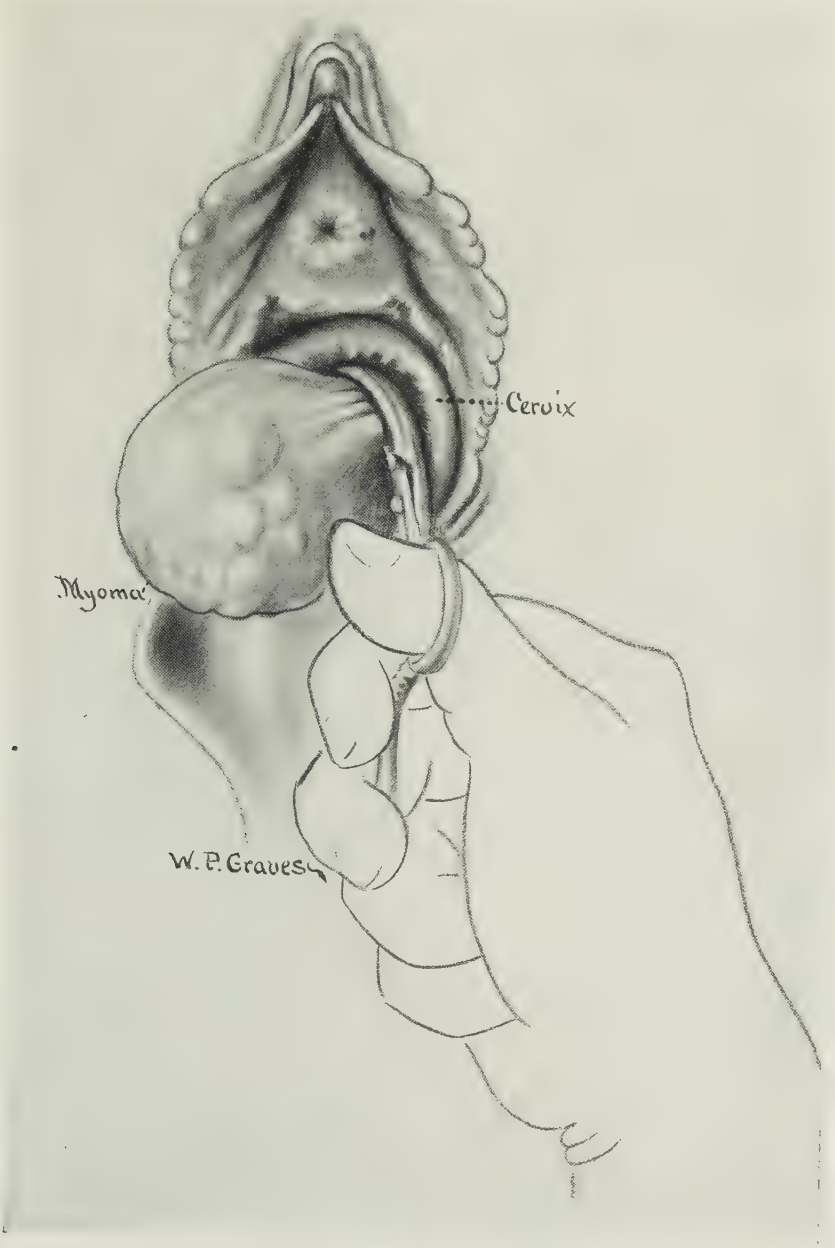


FIG. 459.—VAGINAL MYOMECTOMY.
Clamping the pedicle.

vessels. The omental graft is then applied to the uterus and stitched in place by a few interrupted sutures of fine catgut as in Fig. 458.

## VAGINAL MYOMECTOMY

By vaginal myomectomy is meant the removal of pedunculated submucous myomata through the vagina, and not, as it is used in some books, the enucleation of intramural and subperitoneal tumors by vaginal section, a procedure which is not recommended by the present writer.

Pedunculated submucous myomata first make themselves evident by bleeding or by a foul discharge, or by both. They are usually necrotic and septic. If they are associated with intramural and subserous fibroids, as they commonly are, it is best to remove the submucous tumor first, and to perform the radical operation for extirpation of the uterus at a later date. Otherwise there is much danger of sepsis.

In removing a polypoid myoma the patient is in the perineal position and, preferably, under full anesthesia. Unless there is some constitutional contraindication, full anesthesia is advisable because of the possibility of a smart hemorrhage.

In performing the operation the pedicle of the tumor is first sought with the finger. If the attachment is high up in the uterus it must be found with a blunt instrument like a pair of uterine scissors. When the pedicle is found, it is enclosed and crushed in the end of a uterine clamp. If the tumor is thoroughly necrotic the clamping will often cause it to fall away from the attachment, and the clamp can be removed without bleeding. If the tumor is not attached too far up in the canal it may often, if necrotic, be easily detached by the end of the finger without serious bleeding. If, however, the pedicle is firm, it must be cut with scissors, which are guided in their direction by the clamp attached to the pedicle.

Removal of the clamp does not often cause more than moderate bleeding. Sometimes, however, the hemorrhage is sufficient to require packing the uterine canal with gauze. The packing is removed on the following day.

Patients from whom a necrotic myomatous polyp has been removed usually run a septic temperature for several days after the operation, with a moderate leukocytosis. It is this condition which serves as a warning not to perform a radical operation on the uterus in the presence of one of these sloughing tumors.

## OPERATIONS ON THE TUBES

### SALPINGO-OÖPHORECTOMY

When the tube and ovary are to be removed together it is essential to determine first whether there has been an inflammatory process in the tube. If there are no signs of previous infection, the tube may be amputated near the uterus, with a short pedicle, without danger of future trouble. If, however, there are indications of salpingitis, whether recent or long standing, the entire tube should be exsected from the cornu of the uterus.

In dealing with an ovarian cyst with a free pedicle a convenient technic is as follows: The torsion, if present, is first reduced, so that the broad ligament pedicle, which was twisted into a rope form, is smoothed out and flat. Two

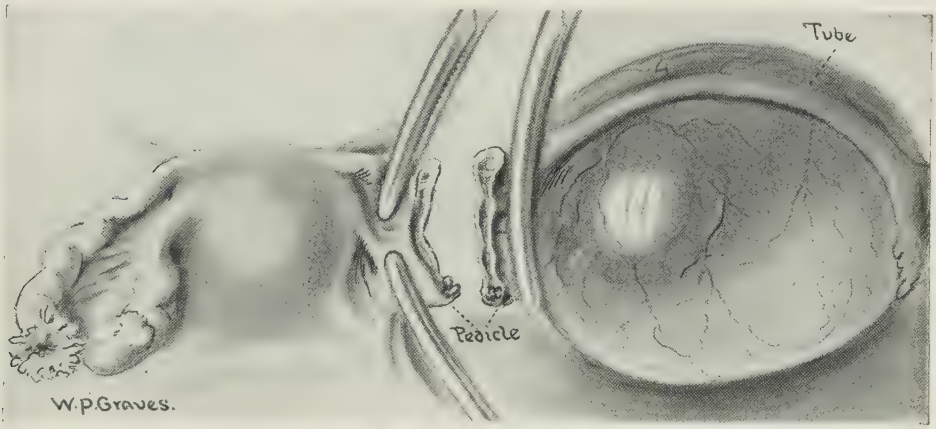


Fig. 460.—Salpingo-oöphorectomy.
Showing method of clamping and cutting the broad-ligament pedicle of an ovarian cyst.

clamps are then applied, meeting each other at an angle near the base of the broad ligament. One clamp near the uterus includes the tube and ovarian ligament, while the other includes the infundibulopelvic ligament, which contains the ovarian vessels. The tumor mass over which the tube is usually spread is then removed by cutting the broad ligament pedicle in a V shape, and in such a manner as to leave a margin of tissue beyond the clamps. If the tumor possesses a large blood-supply, the spilling of reflux blood from the tumor can be avoided by placing distal clamps and cutting between the two sets of clamps. This prevents soiling the field of operation.

When the tumor has been removed the two clamps on the stump of the broad ligament are shifted to the corners, an assistant clamping the ends of the three

or four vessels that bleed from the cut edge. The tube and vessels are then tied separately, two ligatures being applied to the ovarian vessels. The two clamps which are attached to the ends of the V-shaped pedicle are approximated, and the wound edges very carefully united with a continuous No. 0 catgut stitch beginning at the apex of the V. It is possible in this way to close the wound with a minimum exposure of raw edge, a matter of very great importance in the avoidance of future pelvic adhesions. Special care must be taken when completing the suture in uniting the stump of the tube to the stump of the infundibulopelvic ligament not to leave a clumsy mass of tissue and knots. If for any reason this is unavoidable, the round ligament can be drawn over the mass and stitched so as to prevent its exposure and possible adherence to the intestines.

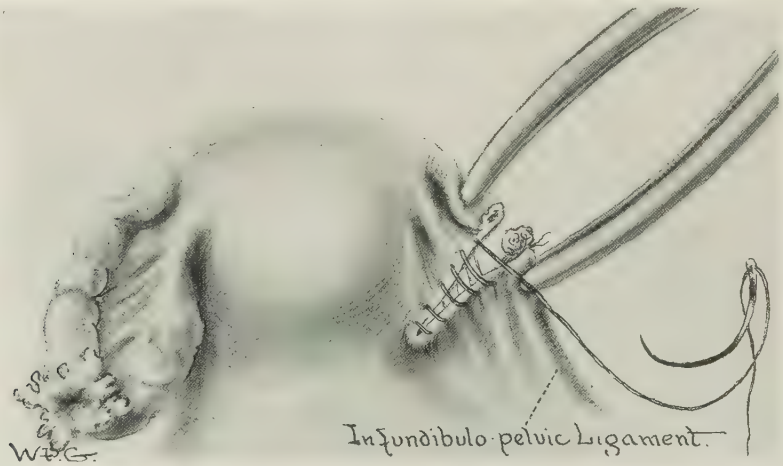


FIG. 461.—SALPINGO-OÖPHORECTOMY.
Closure of the wound in the broad ligament by approximating the stump of the infundibulopelvic ligament to the stump of the tube.

After performing a salpingo-oöphorectomy the uterus should always be suspended by a round ligament operation, even if its position at the time of operation is perfectly good, for if this is not done a later retroversion is almost inevitable.

## SALPINGECTOMY

Exsection of the tube without removal of the ovary is an operation used in the conservative surgery of pelvic inflammation. Where this operation is done it is not enough to amputate the tube at the uterine cornu; it must include a resection of the interstitial portion of the tube to prevent the possibility of a later exacerbation of the disease in the tubal isthmus.

In order to hold the tube in position for easy dissection the edge of the mesosalpinx between the fimbriated extremity and the ovary is seized by a clamp or pressure forceps. Another clamp, preferably with teeth, is applied to the

tissue of the uterine fundus beyond the tubal isthmus. The tube is then removed by cutting through the mesosalpinx, avoiding as much as possible the veins of the broad ligament. A few bleeding points require ligature. When the dissection has reached the uterus the remaining portion of the tube is removed with a knife by cutting a deep wedge-shaped piece of uterine tissue from the cornu. In this way the entire tube, including its isthmus, is exsected. When the incision is made into the uterus a spurting vessel is always encountered. It is important to tie this vessel in such a way as not to distort the tissue or expose too much catgut.

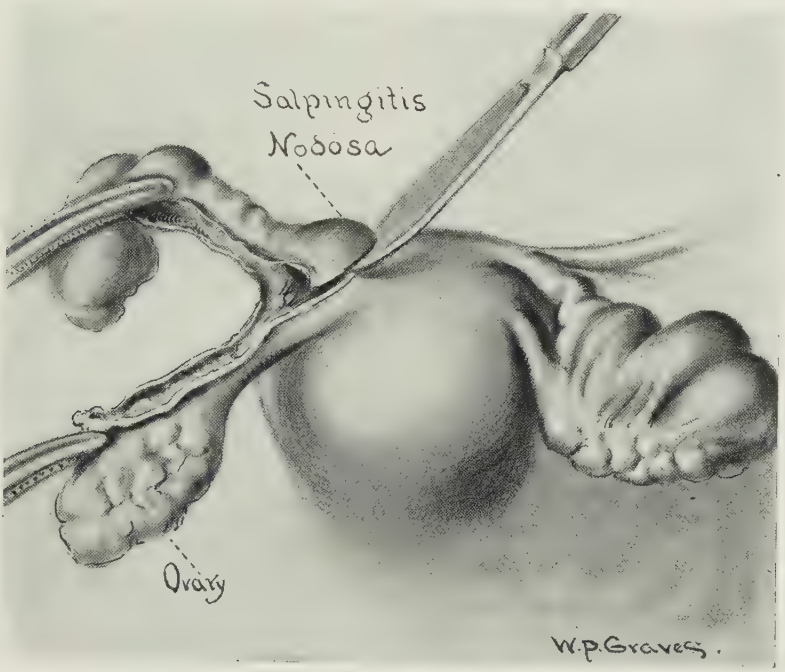


FIG. 462.—SALPINGECTOMY.
Showing the method of completely removing the tube, including the isthmus, which is apt to be implicated in the inflammatory process (salpingitis isthmica nodosa).

The success of the operation depends to a great extent on the manner of sewing up the wound, which must be done so as to leave as smooth a peritoneal surface as possible and to avoid the exposure of catgut knots.

A convenient method of closing the wound is to begin at the uterine end and first place deep into the uterine wall a figure-of-8 stitch of No. 1 catgut. This closes the wedge-shaped opening in the cornu. It can be made to include the spurting vessel alluded to above. The peritoneal edges of the mesosalpinx are now united with a continuous fine catgut stitch. By using the Lembert method of applying the stitch the eversion of raw edges may be avoided, and the catgut knots on the vessels can be covered in. If, however, as is often the case, there have been many adhesions, the mesosalpinx wound is ragged and the

peritoneal surfaces damaged. In such a case it is impossible, even with the most painstaking care, to leave a wound which can be insured against the for-

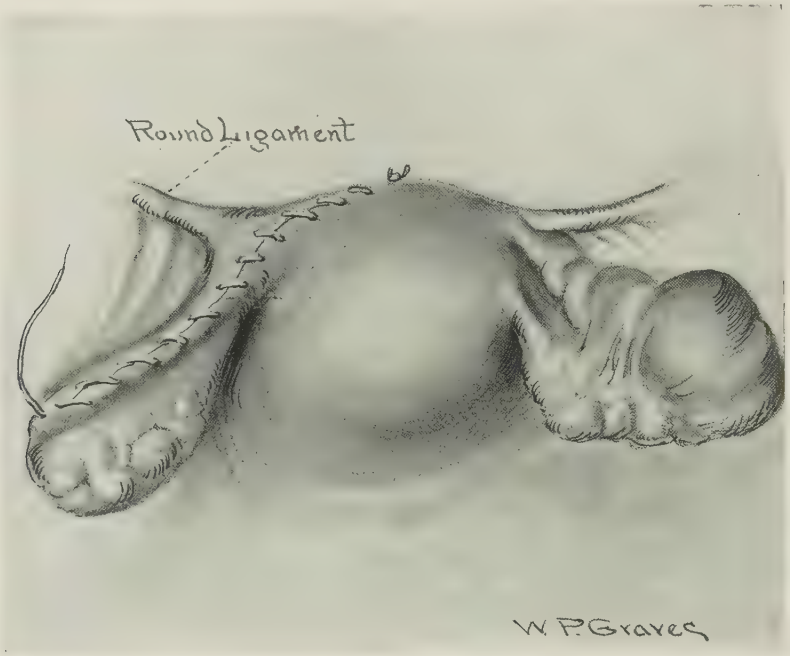


Fig. 463.—Salpingectomy.
The tube of the left side has been exsected, including the isthmus, and the wound in the peritoneum closed by a running suture.

mation of postoperative adhesions. It is for this reason chiefly that conservative surgery for pelvic inflammatory disease so often results in failure.

### SALPINGOSTOMY (STOMATOPLASTIC)

As stated above, when it is necessary to remove a tube that has been damaged by infection, it is not good surgery to leave any part of it, on account of the danger of a later recurrent inflammatory process in the remaining stump. It is necessary, however, sometimes to take this risk when the desire for children surmounts all other considerations. The chances of impregnation through a damaged and resected tube are, to be sure, not very promising, yet the possibility is present, and, according to the author's figures, is somewhat greater than is ordinarily supposed.

In deciding on a stomatoplastic operation on the tube the pelvic organs must first be thoroughly freed of adhesions and the tubes and ovaries carefully inspected. Only those organs are chosen for preservation which offer a reasonable chance of regaining proper function. Thus, a tube which shows a salpingitis nodosa at the cornu is entirely hopeless and should be removed completely.

A tubo-ovarian mass in which there is much destruction of the ovarian tissue, such as results from combined abscess or cyst of the two organs, must also be removed entire.

A tube which is closed and adherent at the fimbriated extremity, but without thickening of the wall or occlusion of the proximal part of the canal, even if it is somewhat distended (hydrosalpinx), is suitable for resection. The presence of one good ovary is, of course, essential, but the ovary may be on the opposite side from the tube to be repaired, for it has been shown that impregnation can take place as the result of migration of the ovum across the pelvis.

In case one or both ovaries are good, but both tubes are impossible, the only chance for pregnancy is by transplantation of ovarian tissue in the uterine cornua.

To perform the operation of salpingostomy the tube is held up to view by attaching a clamp to the edge of the mesosalpinx. The tube is then trimmed

FIG. 464.—SALPINGOSTOMY.
Showing the method of creating a new ostium for a tube closed by inflammation. This operation is performed only for the purpose of restoring fertility.

away from the ovary up to a point where the tubal wall begins to have a normal look, usually about a third to a half of the length of the tube from its extremity. Bleeding points are tied with fine catgut. The mesosalpinx is grasped with fine pressure forceps close to the tube at the point where it is to be amputated. It is important not to crush the tube at any time with clamps or forceps. The tube is then cleanly amputated, and a probe passed gently into the canal to determine whether or not it is patent. This can be done for only a short distance, for it is impossible to determine the patency of the tube near the uterus even under normal conditions, it being too small to admit a fine probe without danger of injuring the tubal mucous membrane. The question of patency in this part of the tube must, therefore, be guessed at from its general appearance.

The tube is then slit up a short distance in order to make the new ostium

wider. The mucous membrane of the tube is next united to the peritoneal covering with sutures of No. 00 catgut passed in a very fine needle. It is important to accomplish this with as few stitches as possible, for the catgut knots are especially liable to promote adhesions. It is usually necessary to use only three sutures, as seen in Fig. 422.

Another method for performing a stomatoplastic operation on the tube is that proposed by Bell and illustrated by Fig. 423. This operation is applicable where there has been a closure of the fimbriated end without serious damage to

Fig. 465.—Bell's Salpingostomy.

A longitudinal incision is made in the closed and dilated end of the tube. The perineum and mucous membrane of the tube are united with a hemstitch suture.

the tubal wall or closure of its lumen. A long longitudinal incision is made near the end of the tube. The edges of the wound are whipped over with a hemstitch of fine catgut.

### OPERATION FOR TUBAL STERILIZATION

It is occasionally important to sterilize a patient without the removal of any of the organs. Simple tying of the tubes is quite inadequate, as the lumen of the tube becomes readily re-established. The same is true of section of the tube and ligature of the cut ends.

The best operation is that described by Crossen in his text-book. The description of the operation and the drawings are borrowed from Crossen.

1. The tube is seized with a forceps about $\frac{1}{2}$ inch (1 cm.) from the uterus. Another forceps is thrust through the broad ligament just under the tube and opened widely. A ligature is then placed in the forceps and the forceps closed and withdrawn. The ligature is tied firmly about the tube, distal to the forceps

which grasps the tube. The ligature is cut short and the tube is divided between ligature and the forceps.

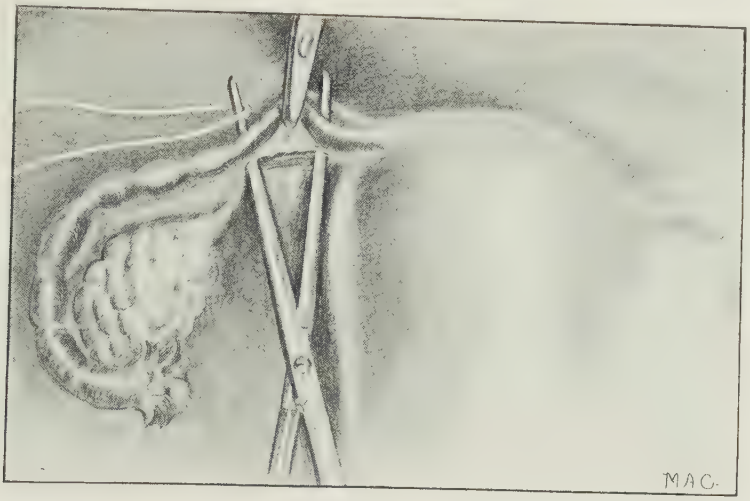


FIG. 466.—OPERATION FOR STERILIZATION.
The tube has been picked up and a forceps pushed through the broad ligament beneath it and opened widely, thus isolating that portion of the tube for a considerable distance. A ligature is ready to be caught in the forceps and drawn through (after Crossen).

2. The ligated end of the tube is buried between the layers of the broad ligament by closing the peritoneum over it.

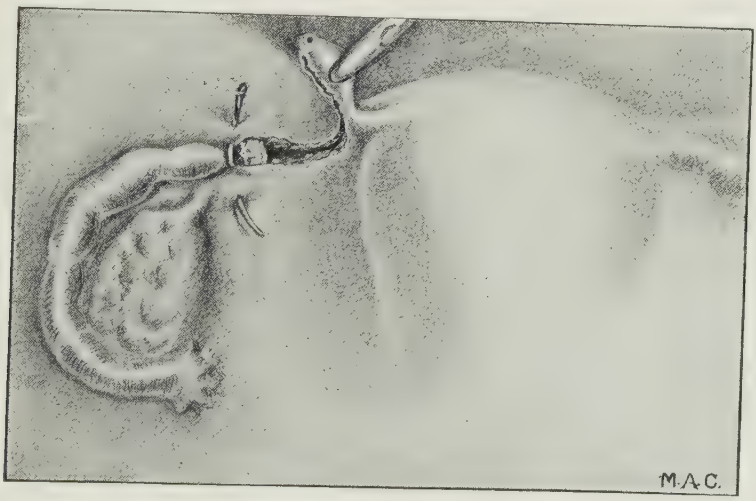


FIG. 467.—OPERATION FOR STERILIZATION.
The tube has been ligated and divided and the ligated end is being buried between the layers of the broad ligament (after Crossen).

3. The proximal portion of the tube is excised into the uterus. The principal bleeding is checked by a ligature at the uterine horn, and then the wound

is closed by deep and superficial sutures. The hemostasis and wound closure may be accomplished by a single thread or by separate sutures.

FIG. 468.—OPERATION FOR STERILIZATION.

The ligated end of the tube has been buried. Its location between the layers of the broad ligament is indicated by the dotted outline. The vessels to the proximal end of the tube have been ligated and the stump of the tube is being excised, the excision to extend to the uterine wall (after Crossen).

FIG. 469.—OPERATION FOR STERILIZATION.

Closing the wedge-shaped wound in the horn of the uterus. The deep portion is to be closed by a buried suture and then the peritoneum is to be accurately approximated by a superficial suture, as here indicated (after Crossen).

4. The round ligament of that side is brought over the wound-area and fastened back of the uterus. This adds to the certainty of the sterilization and also serves to keep the uterus well forward.

## OPERATIONS ON THE OVARIES

### RESECTION OF THE OVARY

This operation does not at present hold the prominent place in gynecologic surgery that it did in the days before it was learned that the so-called cystic degeneration of the ovaries is, for the most part, a physiologic process. There are times, however, when the process passes the physiologic bounds and the operation of resection must be resorted to. This is especially true when one follicle seems to be growing at the expense of the rest of the ovarian tissue, and gives promise of becoming a large retention cyst. The necessity of performing

Fig. 470.—Resection of Ovary.
A follicle cyst is being exsected. The clamps which hold the ovary into view are lightly placed so as not to crush the tissues which they include.

a resection of the ovary in the course of a pelvic operation must, however, always be regarded as a regretable incident, for the likelihood of the ovary's becoming adherent is very great.

The ovary is exposed to view by placing one clamp on the edge of the meso-salpinx and the other on the ovarian suspensory ligament, the clamps being locked just tight enough to hold the ovary in place, but not so as to crush the tissue or shut off the blood-supply. An oval incision is then made around the cyst, exposing the translucent capsule of the cyst, which can easily be shelled out of its bed in the ovarian tissue. If the supporting clamps have not been applied too tightly there is some bleeding from the hilum of the ovary.

All the bleeding should be very carefully stopped by fine catgut ligation. When the bleeding seems to be stopped the clamps should be unlocked, to be sure that they are not accidentally controlling other small vessels. The wound in the ovary is then sewed with fine catgut on a small curved needle. The ovarian tissue is very friable, especially if the operation is near a corpus luteum. The edges should be trimmed until firm tissue is reached, care being taken that the

FIG. 471.—RESECTION OF OVARY.
The cyst has been dissected out of its bed and the wound of the ovary sewed with a fine catgut running stitch.

edges when approximated will give good coaptation without tension and without presenting ragged edges. The greatest care should be taken in sewing the wound so as to leave it as smooth as possible, in order to safeguard against adhesions.

## TRANSPLANTATION OF OVARIAN TISSUE

Transplantation of ovarian tissue is principally employed either for restoration of fertility after a pelvic inflammation, or for the purpose of relieving the vasomotor symptoms of the artificial menopause following hysterectomy.

In the first instance the operation is indicated when it is necessary to remove both tubes, one or both ovaries being normal. The steps of the operation are as follows:

The tube of one side is completely exsected in the manner described for salpingectomy. The wound of the mesosalpinx is carefully closed with the exception of the wedge-shaped opening made in the cornu of the uterus in dissecting out the isthmus of the tube. This small cavity is now examined to make sure that all scar- and inflammatory tissue have been removed. A probe determines whether there is free communication with the uterine canal, though the opening should be small. A slice of tissue about $\frac{1}{4}$ inch thick and the size

of the thumb-nail is taken from the ovary, including epithelial covering, cortex, and medullary layer, and placed in the opening in the uterine cornu, the wound being closed with a figure-of-8 stitch. The wound in the ovary is sewed by a running stitch of fine catgut. The same process is repeated on the other side. If only one ovary has been left, enough tissue must be taken to supply both cornuæ.

The author has recently adopted a new technic for transplanting ovarian tissue into the horn of the uterus when it is necessary to remove both tubes. It is especially applicable in cases of salpingitis isthmica nodosa, or when reverse inflation demonstrates that the isthmus is closed. It is necessary that a

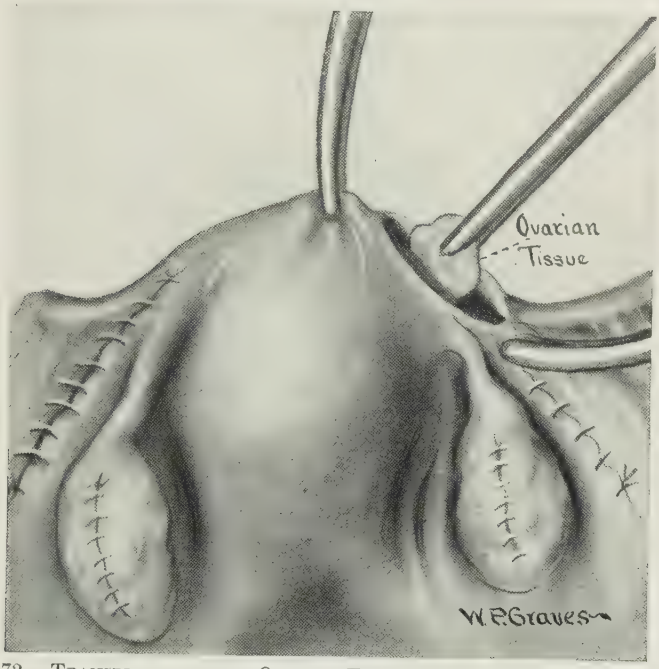


FIG. 472.—TRANSPLANTATION OF OVARIAN TISSUE IN THE HORNS OF THE UTERUS.

The tubes have been exsected. Wedges have been removed from the ovaries and the wounds closed. A section of ovarian tissue is being introduced in the right cornu. The same procedure has been carried out and completed on the left side.

section of the tube be undamaged. About $\frac{3}{4}$ inch of undamaged tube is resected. One end of the tubal cylinder is then closed with fine catgut. The small piece of ovarian tissue is inserted into the lumen and held in place by a single fine catgut suture passed through the tubal wall and the ovarian tissue. After making a competent opening through the cornu into the uterine canal the tubal cylinder with its piece of ovarian tissue is inserted into the cornual opening with the open end of the tube downward and communicating with the uterine canal. It is then stitched into place and the cornual wound closed. The object of this operation is to insure a permanent channel lined with epithelium from the ovarian tissue to the uterine canal.

The operation of transplantation after hysterectomy is as follows: A small receptacle containing warm sterile salt solution is ready at hand. When the uterus and adnexa are removed from the pelvis the surgeon immediately cuts off one of the ovaries and places it in the warm salt solution, where it is kept until the operator is ready to implant it. Numerous locations are used for the implantation, most commonly between the leaves of the broad ligament and in the abdominal wall. Of these two sites, the latter is far preferable, partly because

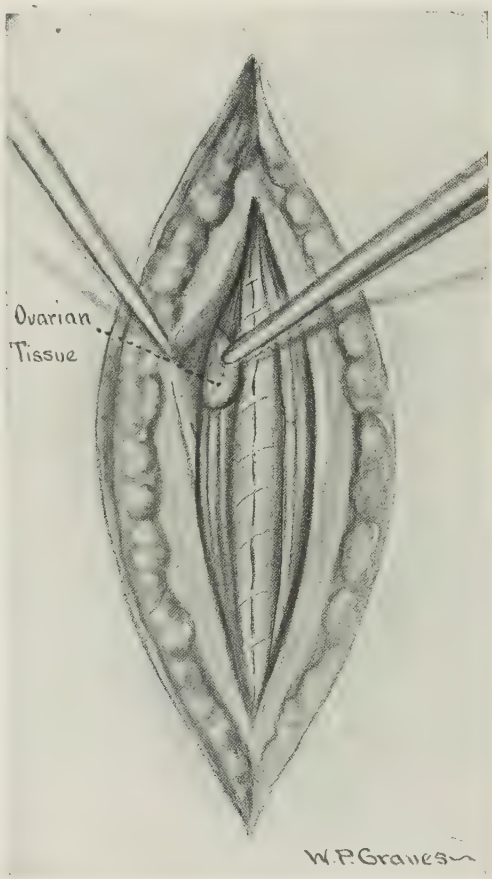


Fig. 473.—Implantation of Ovarian Tissue in Abdominal Wall.
A slice from the ovary is being inserted between the fascia and right rectus muscle.

the blood-supply is more favorable for the graft and partly because it is more accessible if by chance the tissue later becomes cystic or gives trouble otherwise.

If the abdominal wall has been chosen as the site of implantation the operation is completed as far as the closure of the abdominal fascia. A place is then chosen where the sheath surrounds the edge of one of the recti muscles. A small slit is made in the sheath at the muscle border. The ovary is taken from the salt solution and a slice removed from the healthiest part, including, if possible,

epithelium, cortex, and medullary tissue. The piece of ovary is now slipped into the small opening in the muscle sheath (Fig. 473), and placed so that it lies between muscle and fascia. The opening in the fascia is closed with one suture of fine catgut.

It is important to remember that the whole organ should not be implanted in the abdominal wall, for it is almost sure to give trouble later by cystic degeneration. By using a slice of the ovary the establishment of a new circulation in the graft is more surely accomplished than if the intact ovary is implanted.

## OPERATIONS ON THE ABDOMINAL WALL

### BARDENHEUER'S INCISION

An extended transverse incision for difficult pelvic operations is used frequently abroad, but very little in this country. This incision is carried with a moderate downward curve from one anterior superior spine to the other. The incision is made transversely through the entire wall, including skin, fascia, muscle, and peritoneum. As a rule, only the recti are divided, but if the operation demands it the lateral muscles of the abdomen may also be cut.

Fig. 474.—Transverse Incisions for Pelvic Operations.

The shorter of the two red lines indicates the Pfannenstiel incision. The longer red line shows the Bardenheuer incision, sometimes used for extensive pelvic operations. The Pfannenstiel incision cuts only the skin and fascia transversely. The Bardenheuer incision cuts transversely all the layers of the abdominal wall from spine to spine.

This incision gives a great amount of room for manipulations in the pelvis (Fig. 474). Bardenheuer, who first advocated it, recommends also turning down the upper flap of peritoneum and suturing it to the posterior pelvic peritoneum in order to protect the intestines from the field of operation.

This incision is somewhat too radical except for extraordinary cases.

### THE PFANNENSTIEL INCISION

The transverse, or Pfannenstiel, incision for pelvic operations has many adherents, especially abroad, its chief value being based on cosmetic considerations. The use of this incision, the scar of which is entirely concealed by the pubic hair, obviates the ugly appearances so frequently seen after the median longitudinal cut, such as keloid formation, pigmentation, depression, and spreading of the scar. The technic of the operation is as follows:

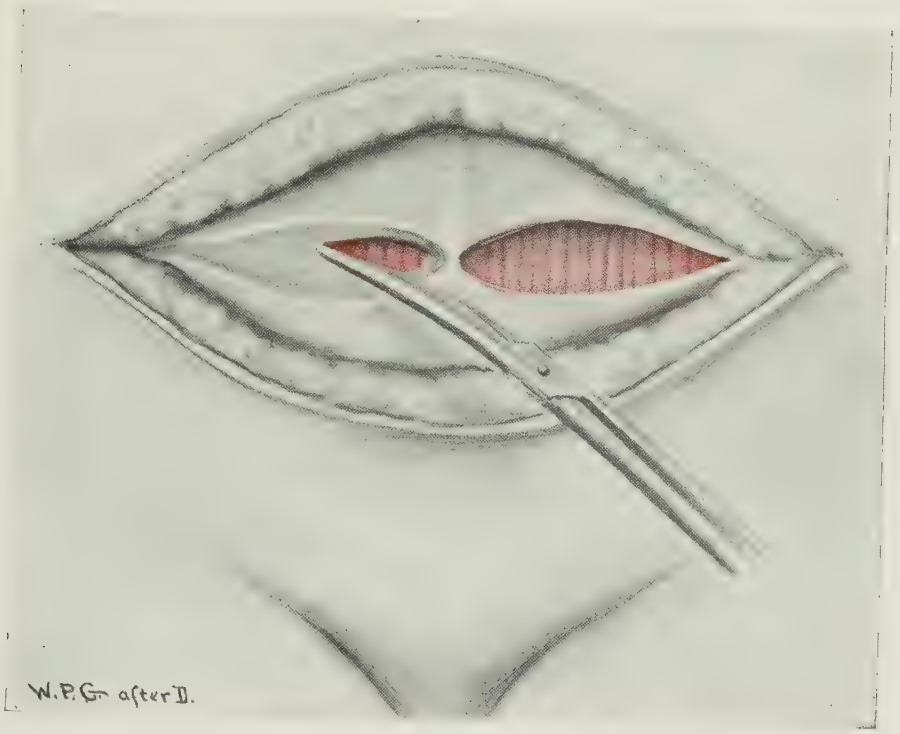


FIG. 475.—THE PFANNENSTIEL INCISION.
The skin and fat have been incised just within the boundary of the pubic hair. The fascia is cut transversely as in the drawing (after Döderlein-Krönig).

A straight or slightly curved transverse incision $3\frac{1}{2}$ inches in length is made above the pubes just within the line of pubic hair. The incision is carried down through skin, fat, and fascia to the rectus muscles. The adhesion of the fascia to the linea alba is then cut away with scissors from the upper and lower fascial flaps (Fig. 430). The recti muscles are separated by blunt dissection, as in the median incision, and the peritoneum is cut longitudinally. The simple incision does not give as good exposure of the pelvis as does the median incision, nor can the appendix and other portions of the abdomen be as easily reached and explored. If, however, the ends of the skin and fascia wound are curved upward, the recti muscles may be drawn more widely apart and a much better exposure

is afforded. This extension of the wound is quite necessary in the performance of the more difficult pelvic operations, such as for myoma, pelvic inflammation, etc. It is also often necessary in the routine removal of the appendix, if it happens to be placed rather high. If the appendix is high and adherent its removal through the Pfannenstiel incision may be attended with much technical difficulty.

The wound is sewed up in layers, and provision must be made to attach the fascia to the rectus muscle to obliterate the dead space consequent on the extensive stripping back of the fascial flaps.

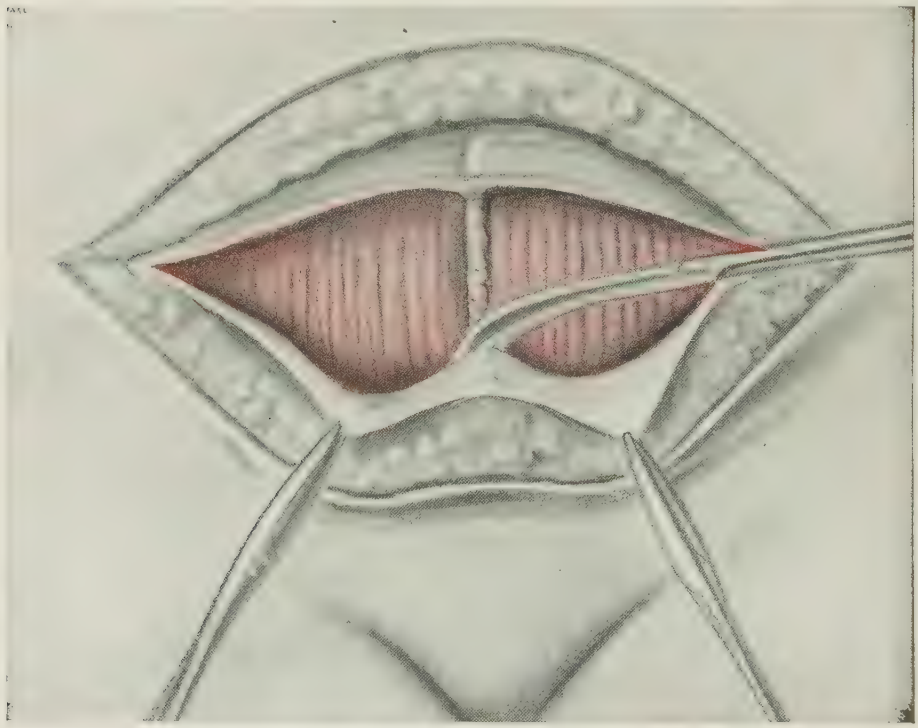

FIG. 476.—THE PFANNENSTIEL INCISION.
The fascia has been cut transversely and is being stripped back from the rectus muscles. The attachment at the linea alba is trimmed away with scissors (after Döderlein-Krönig).

In addition to the cosmetic value of the incision, other advantages are claimed for it. Postoperative hernia is supposed to be less common following it. Patients are able to get up earlier during convalescence and do not require abdominal binders. On the other hand, it has the important disadvantage of having considerably greater tendency than the longitudinal wound to become infected. It also requires more time during the operation, both in making and in closing it.

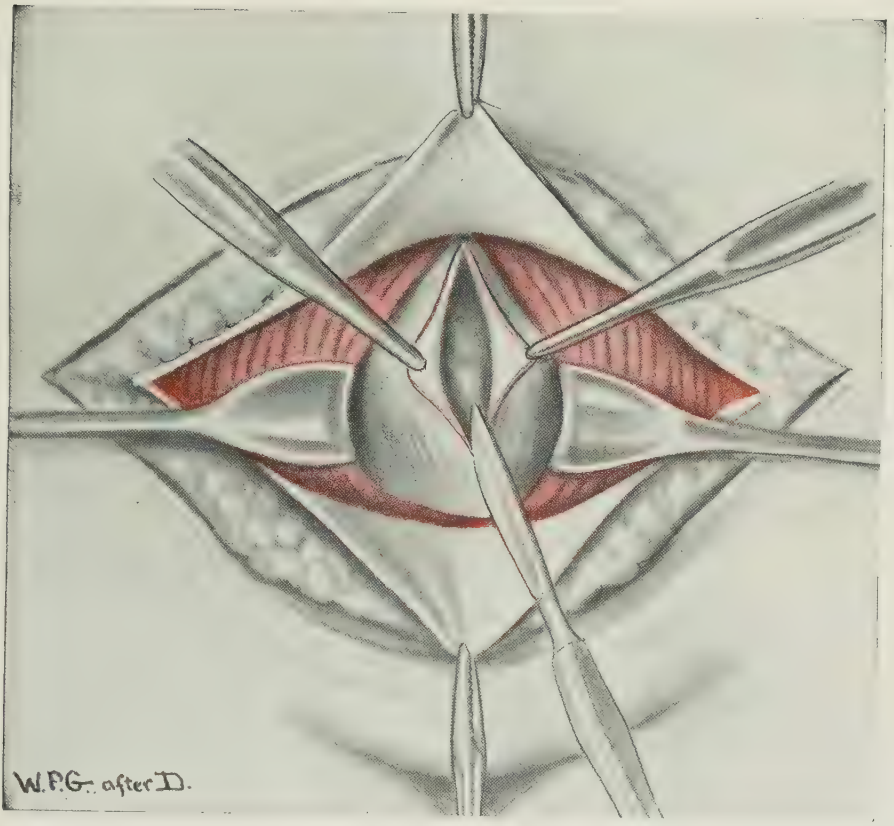


FIG. 477.—THE PFANNENSTIEL INCISION.

The fascia has been stripped back from the rectus muscles above and below. The rectus muscles have been separated in the middle line and the peritoneum is being opened longitudinally (after Döderlein-Krönig).

## DIASTASIS OF THE RECTUS MUSCLES

In order to determine the extent of the diastasis of the rectus muscles during a pelvic operation the left hand is placed in the wound, palm up, with the middle finger at the umbilicus. By lifting up the abdominal wall with the hand in this position the thinned-out central portion of the wall becomes apparent, while the edges of the separated rectus muscles can be readily felt.

In most cases of abdominal relaxation the abnormal separation of the muscles extends above the umbilicus. When the pelvic operation has been finished the skin incision is enlarged to about 2 inches above the umbilicus. The incision is not carried deeper than the fat. The skin and fat layer is then dissected widely away from the aponeurosis (the attachment of the umbilicus being severed) until the edges of the rectus muscles are reached. It is important that the aponeurosis should be well cleaned of fat. When all vessels have been tied, sutures are placed in such a way as to infold the abdominal wall and bring the divergent muscles into close union. This can best be done by employing the

"pulley stitch" (Fig. 479). Beginning at the upper end of the field, a suture of some strong material is carried first deeply into the aponeurosis of the right side near the edge of the muscle; it is then introduced superficially into the aponeurosis of the other side; again, it is brought back and passed superficially in

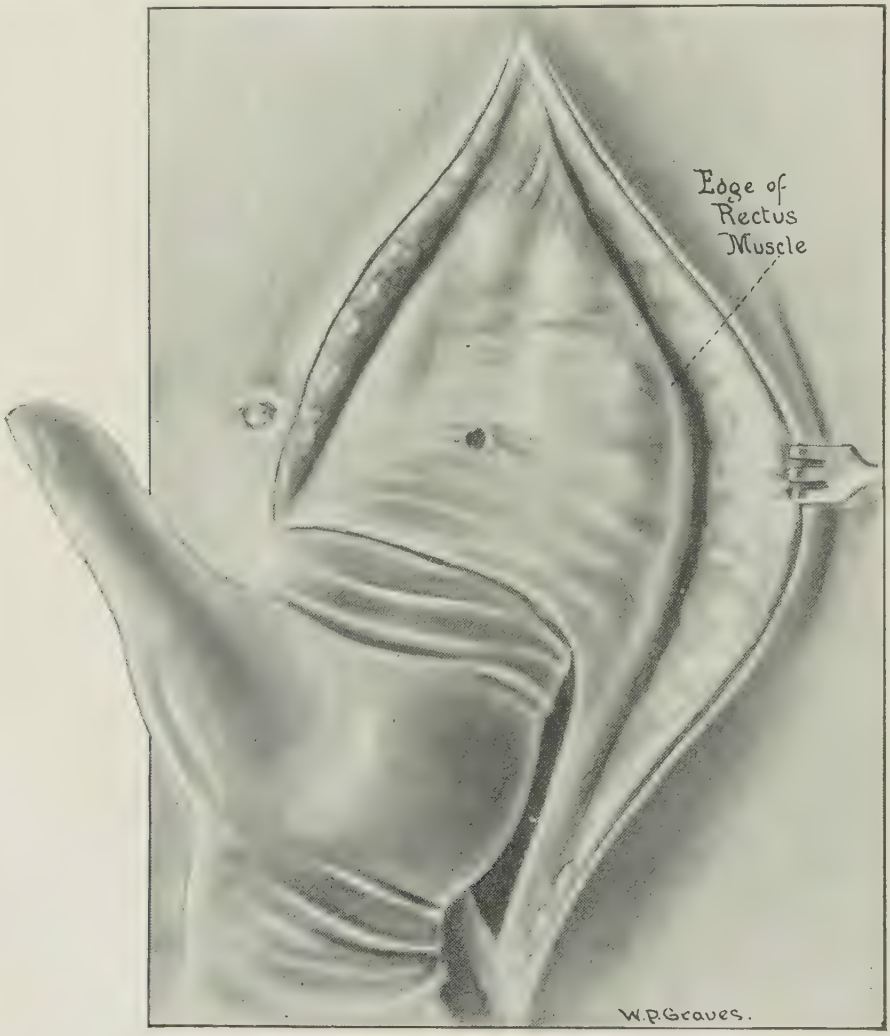


FIG. 478.—OPERATION FOR DIASTASIS OF THE RECTUS MUSCLES.

The fat has been pushed far back from the fascia, the umbilicus cut across. The thin layer of tissue intervening between the separated recti is demonstrated by inserting the hand as in the drawing. The edges of the rectus muscles can be seen or felt.

the right side; and, finally, deeply into the left side (Fig. 480). When the ends of the suture are drawn away from each other the intervening aponeurosis is infolded and the edges of the muscles are firmly approximated. When the suture is tied the approximation is greatly reinforced. The suture material to be used depends upon the extent of the diastasis and the amount of tension

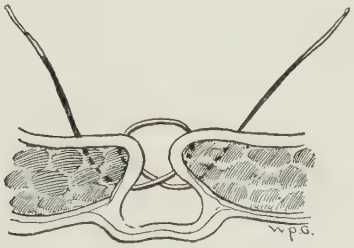

FIG. 479.—PULLEY STITCH.
Used for reduplicating the fascia and approximating the bellies of the muscles in operations for hernia and diastasis of the recti.

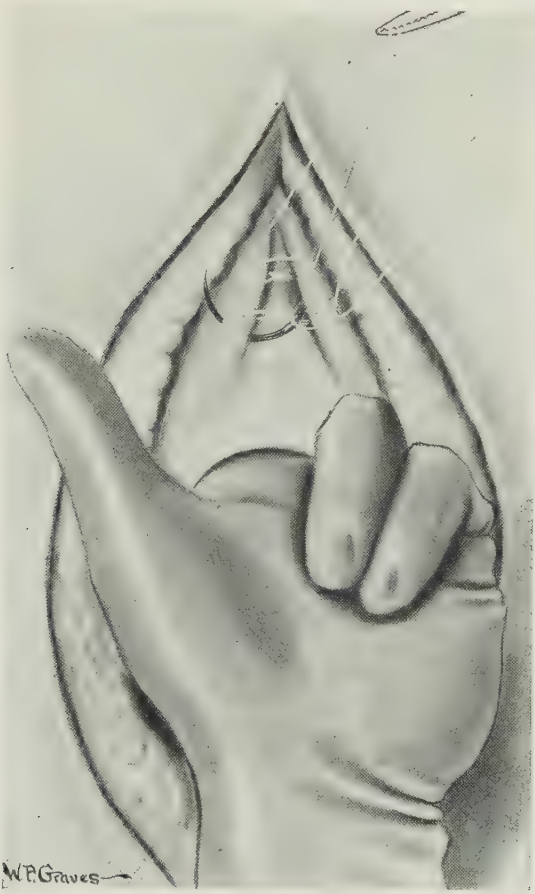


FIG. 480.—OPERATION FOR DIASTASIS OF THE RECTUS MUSCLES (AUTHOR'S METHOD).
Introduction of the pulley stitches through the fascia at the borders of the rectus muscles. Two fingers of the left hand are inserted in the abdominal wound to guide the direction of the sutures and to avoid injuring underlying intestine. The sutures should not be carried through the entire wall. They include only the fascia and part of the muscular tissue.

requisite to unite the muscles. If the tension is very great, it is best to use a No. 7 braided silk doubled or strong linen. If the tension is moderate, No. 2

chromicized catgut doubled may suffice. The object in doubling the suture is to avoid cutting through the tissues.

The approximation pulley stitches are placed about $\frac{1}{2}$ or $\frac{3}{4}$ inch apart, down to the upper end of the primary incision, or, if the incision is a very long one, to about $2\frac{1}{2}$ inches below the umbilicus.

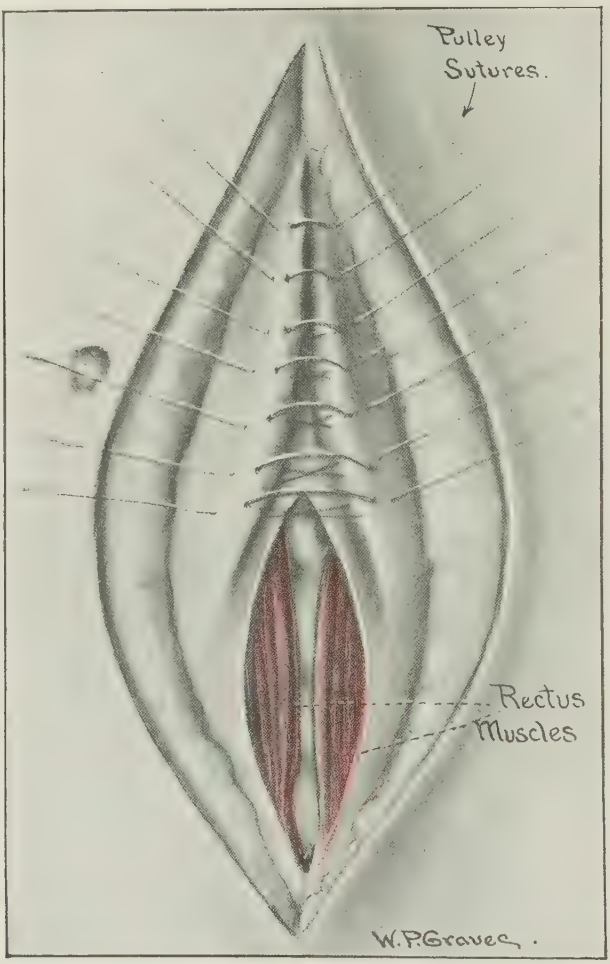


Fig. 481.—Operation for Diastasis of the Rectus Muscles (Author's Method).

Pulley stitches have been introduced through the fascia at the borders of the separated recti. The lower part of the wound where the incision into the abdominal cavity has been made is closed in layers in the usual way, the rectus muscles lying in close approximation after the pulley stitches have been drawn and tied.

The use of the pulley stitch is the most powerful method of approximating tissues that we possess and can be used in most cases where great tension must be overcome.

## OPERATION FOR UMBILICAL HERNIA (AUTHOR'S METHOD)

The basic principle involved in this operation is that in order to secure adequate support for the new wound and to insure against a recurrent hernia of the scar, the rectus muscles, which in all cases of umbilical hernia are separated, must be reunited not only at the site of the hernia, but for a considerable distance above and below.

A long incision is therefore made, as in Fig. 483, in the median line above and below, but encircling the protruding mass. The first step is to dissect out the sac, cutting deeply in the surrounding fat until the white, firm tissue of the aponeurosis over the rectus muscles is reached. The dissection is then carried on until the hernial ring is clearly developed. When the sac is very large it is often found lying far over on the side of the abdomen, more or less adherent to the aponeurosis (Fig. 482). To one unfamiliar with this condition the development of the ring is at first confusing.

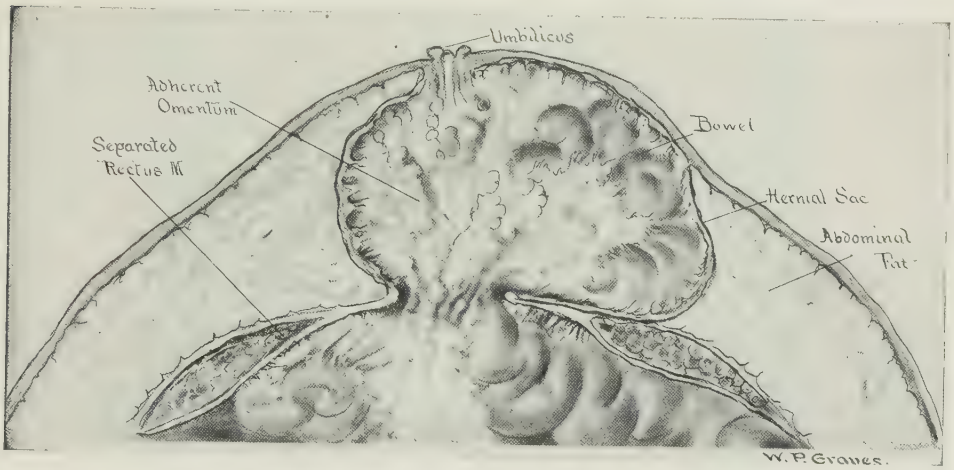


FIG. 482.—UMBILICAL HERNIA.

Transverse section of abdomen showing diastasis of recti, hernial sac, and adhesion of intestines and omentum to the sac wall. The way in which the hernial sac folds over on the fascia and becomes one-sided is shown. Also the disappearance of fat immediately over the hernia.

When the sac and ring have been clearly exposed an attempt is made to empty the sac of its contents, which cannot be done if there are adhesions inside the sac or along the edge of the ring. If there are no adhesions the sac is opened and trimmed off at the ring. If adhesions are present the sac must be opened with great care, so as not to injure a possible loop of intestine. The adhesions of the omentum or intestines to the inner surface of the sac and the ring are freed and the contents dropped back into the abdominal cavity. The freeing of the adhesions may be attended with much difficulty. In our experience the best and safest technic in this tedious task is the use of the Mixter curved dissecting scissors. The temptation to use gauze dissection should in all cases be resisted, for no other method is so prolific of trauma to the intestines. An

important maneuver in the dissection of adhesions involving the bowel is to loop the left forefinger under the adhesion and lift it firmly up. By this means a resisting surface is given for the dissection, and, at the same time, a better opportunity for differentiating the tissues.

In freeing the adhesions from the edge of the ring it will usually be found that they involve a considerable margin of the peritoneal surface around the ring. All the adhesions should conscientiously be freed—not only those attaching omentum and intestine to the peritoneum of the sac and abdominal wall, but also those uniting loops of intestines together. If injury is done to the

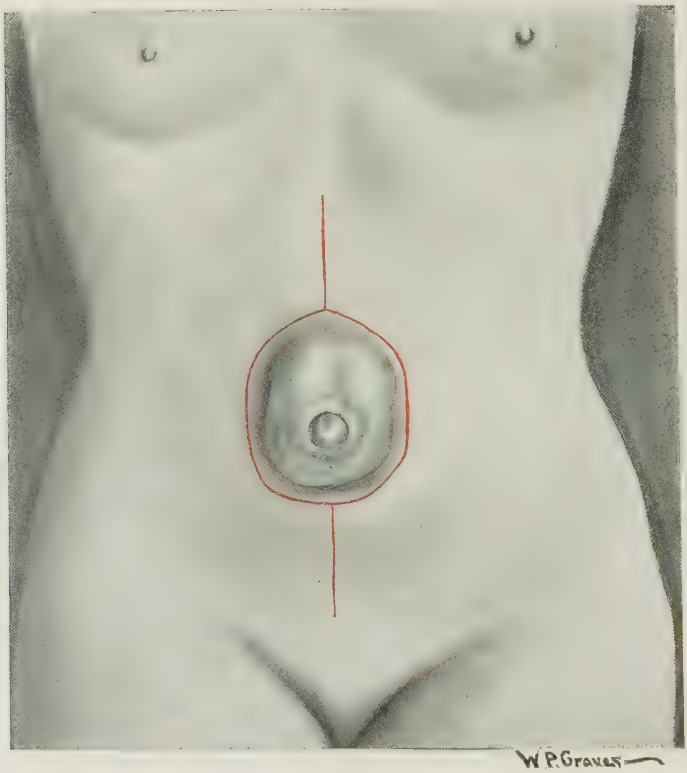


Fig. 483.—Umbilical Hernia (Author's Method).
The incision is indicated by the red line.

seromuscular coat of the intestinal wall, it must be repaired with fine catgut. In some cases it is advantageous to graft a piece of omental fat over raw surfaces that cannot otherwise be protected.

When all adhesions have been released the omentum is pulled down under the wound and a flat gauze handkerchief inserted. The skin wound is then greatly enlarged by extending the median incision toward the pubes and toward the ensiform cartilage. The fascia on each side of the wound is widely exposed by dissecting back the fat. At this point, in the case of a large hernia, the skin wound extends nearly the whole length of the abdomen.

The ragged remnants of the hernial sac are now trimmed away and the wound through the abdominal wall extended downward, but *not upward.*

Next the layers of the abdominal wall are cleanly dissected out and isolated in the lower half of the wound, *but not in the upper half.* This will be understood by referring to Fig. 481. In order to expose the bellies of the rectus muscles

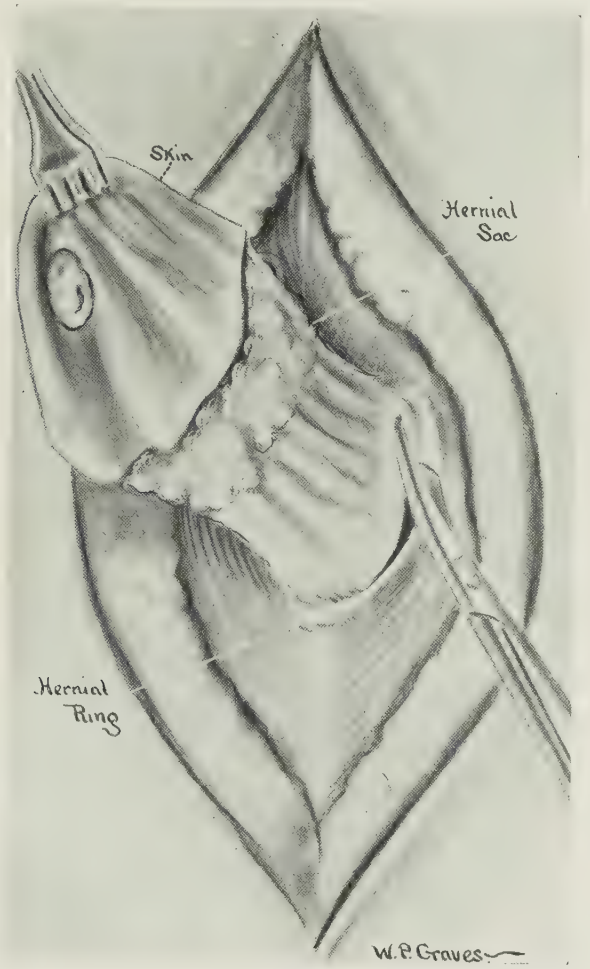


FIG. 484.—UMBILICAL HERNIA.

The hernial sac has been dissected away from the surrounding abdominal fat and lifted up from the fascia. The sac is being cut away at the hernial ring. If the sac contains adherent omentum and loops of gut the opening must be made in the most convenient place, and all adhesions of the sac and ring removed before the sac is trimmed off.

it is necessary to run the scissors along the inner edge of the sheath which encloses them.

The next step is the application of sutures so as to approximate the rectus muscles along their entire length, and in doing so the plan is to bring them together by reduplication of the fascia in the upper half and by union of the

layers in the lower half. The reason for this is, that if the layers of the upper half are dissected out and an attempt made to approximate them, it will be found that they are unable to stand the tension. The muscles, however, can be brought together by reduplication of the uninjured fascia, which is very power-

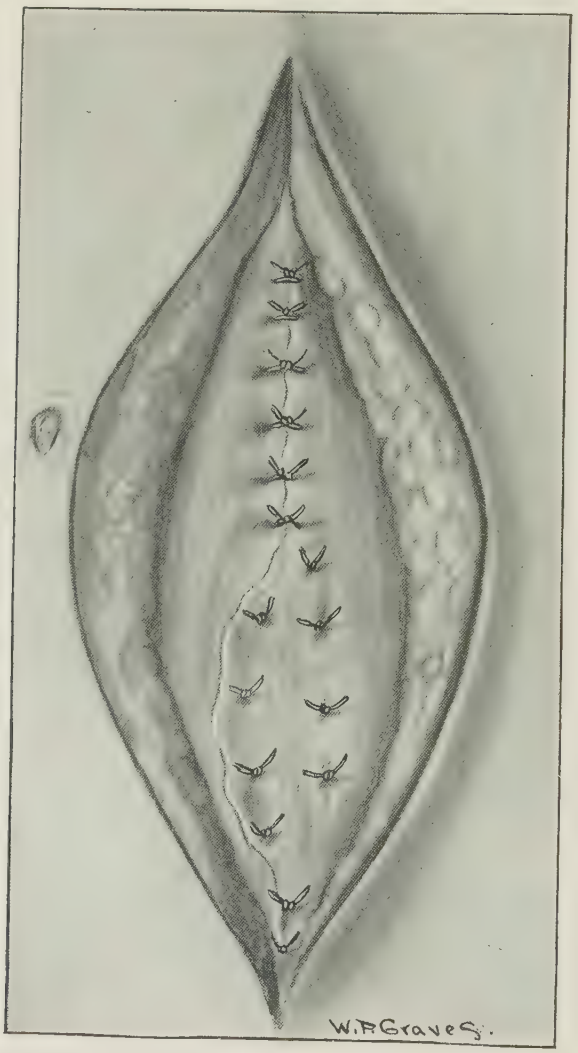


FIG. 485.—ABDOMINAL HERNIA (AUTHOR'S METHOD).

Stitches tied. The stitches of the upper single row are all pulley stitches. If there is much tension, they should be of strong silk or linen. If the tension is only moderate, strong catgut (No. 2 chromicized) is sufficient. The fascia of the lower part of the wound is overlapped and sewed with two rows of interrupted chromic catgut sutures.

ful. It will be found that when the upper half of the recti are reunited in this way the bellies of the lower half lie closely together, requiring no further tension to approximate them.

In placing the sutures the peritoneum is first sewed for a few inches, the

end of the suture being left long. The left hand is then inserted beneath the layer of tissue that intervenes between the separated recti muscle and a series of pulley stitches applied, beginning at the top of the wound (Fig. 480). If no very great tension is required, they may be of No. 2 chromicized catgut doubled. If great tension is necessary to approximate the edges of the muscles, it is neces-

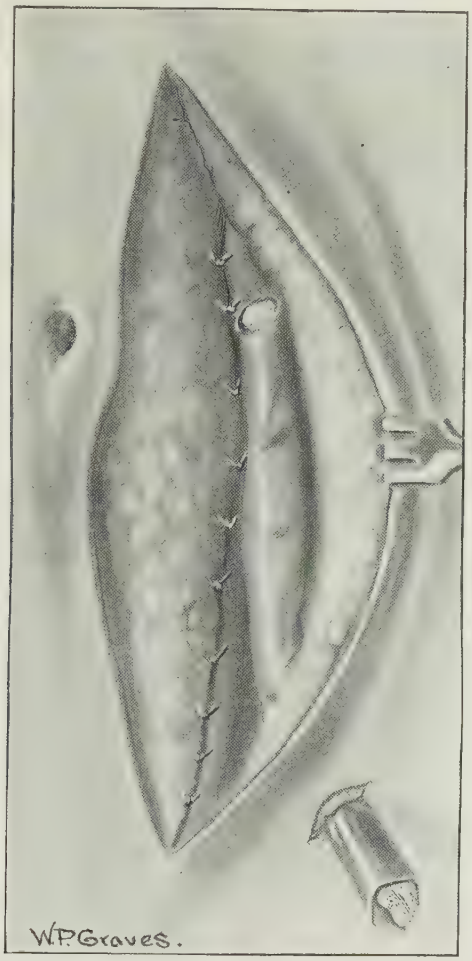


Fig. 486.—Abdominal Hernia (Author's Method).

The fat of one side is stitched down over the row of sutures in the fascia. This is to protect them in case of wound sepsis and is especially important when silk or linen has been used. A cigarette drain is placed in the wound through a lateral stab-wound. It is a good plan to leave the end of the drain long enough so that it can be withdrawn without disturbing the dressing and binder.

sary to use a non-absorbable stitch, either No. 7 braided silk or strong Pagenstecher linen. The suture should usually be doubled to insure against cutting through the tissues.

The pulley stitches are applied as pictured in Fig. 480, the left hand guarding against possible puncture of the abdominal wall and injury to the bowel. They

should not be carried through the peritoneum, but may dip deeply into the muscle.

After placing the pulley stitches they are drawn tight and tied. The suture of the peritoneum is then completed and several interrupted catgut stitches inserted in the rectus muscles, which now lie in close union. The fascia of the lower half of the wound is overlapped as depicted in Fig. 485.

We now have a very long wound, usually with much fat, and numerous bulky knots in the fascia, all factors favorable for sepsis. In order to provide against

Fig. 487.—The Mayos' Operation for Umbilical Hernia.
Showing the position of the initial incision and the hernial ring after dissection of the sac.

this, the fat of one side of the wound is stitched with fine catgut to the fascia so as to cover and protect the line of sutures. In order to prevent the accumulation of serum and dissolved fat in the wound it is drained by a Penrose tube passed through a stab-wound. The end is left long enough so that it may be extracted in two or three days without disturbing the dressing.

In applying the dressing a continuous strapping with surgeon's plaster should be used. The most effective swathe is the three-tailed binder devised by Rockey.

The patient should be kept in bed three weeks.

### THE MAYOS' OPERATION FOR UMBILICAL HERNIA

A simple and popular method of operating on umbilical hernia, and one from which excellent results are reported, has been devised by the Mayos.

It consists in making a large transverse elliptic incision including the hernia and a considerable amount of adjacent fat. The hernial mass is removed as in the preceding operation, the sac opened, and all adhesions freed. The wound in the fascia is enlarged transversely until the edges of the rectus muscles

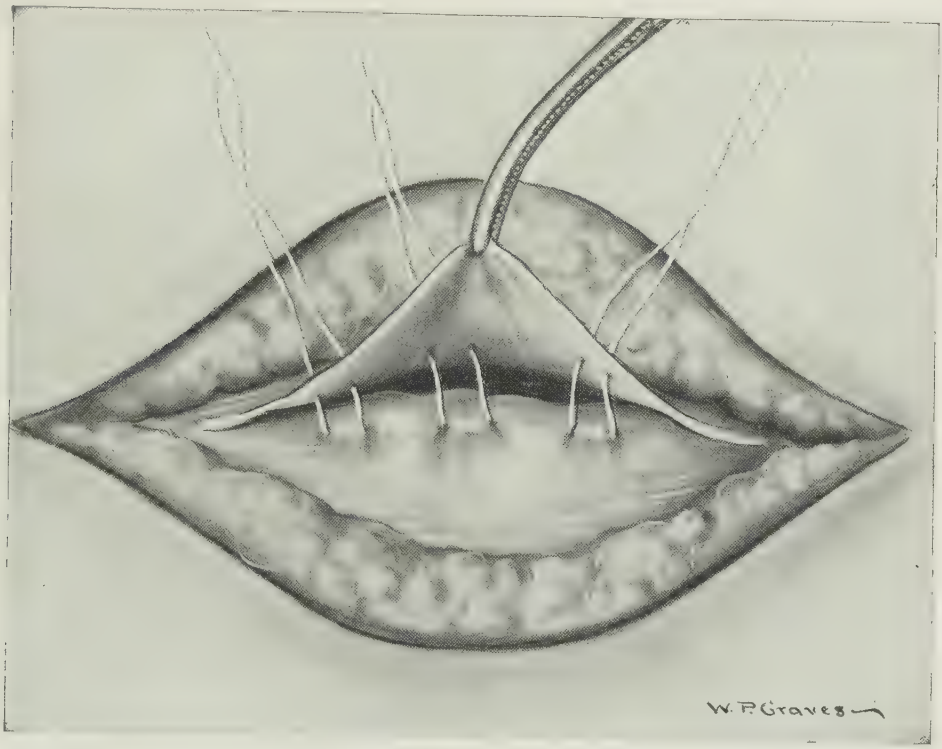


FIG. 488.—THE MAYOS' OPERATION FOR UMBILICAL HERNIA.
The hernial sac has been removed. The fascia is being overlapped and secured by mattress sutures.

are reached. The upper flap of fascia, together with its peritoneal lining, is then lapped over the under flap, and attached in this position by a row of mattress sutures passed from the edge of the lower flap. The edge of the upper flap is stitched down on the underlying fascia.

Numerous other excellent operations have been devised. Graser performs an operation which combines the principles of the two operations described above. He makes a transverse incision, dissects out and approximates the rectus muscles, and sews up the fascia transversely. Blake and Webster have developed operations similar in principle to the first operation described.

### OPERATION FOR POSTOPERATIVE HERNIA

The operation for postoperative hernia used by the author is in principle like that for umbilical hernia, though for hernias that occur in scars of low pelvic operations the wound need not be so long. The principle to be observed is to unite the rectus muscles at a considerable distance above the hernia, so that at the site of the hernia there is no lateral tension in approximating the edges of the various layers of the abdominal wall. The method of re-

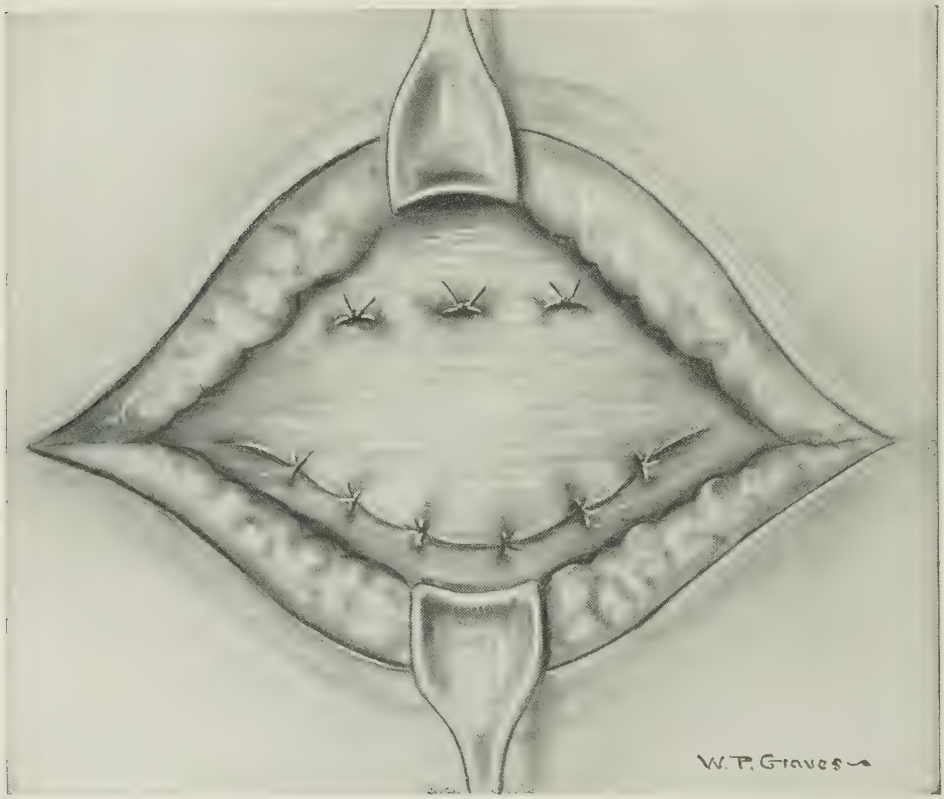


Fig. 489.—The Mayos' Operation for Umbilical Hernia.
Final step of overlapping and securing the fascia.

duplicating the fascia at the point where there is greatest tension instead of dissecting out the layers is to be observed in these hernias, as in the umbilical type.

### TRANSPLANTATION OF FASCIA FOR POSTOPERATIVE HERNIA

In some cases of abdominal hernia neither the operation of approximating the rectus muscles nor the overlapping of flaps of fascia is feasible on account of causing too great tension on the tissues of the abdominal wall. In order to meet this contingency various devices have been employed, such as the insertion of

metal plates, wire gauze, etc. These methods, though occasionally successful, are unsatisfactory and in principle unsurgical.

A more rational method that bids fair to become of great importance in the treatment has recently been introduced, and consists in the transplantation to the abdominal wall of fascia taken from the thigh. The technic employed by Willard Bartlett and depicted in Figs. 490–492 is as follows:

A free incision is made over the hernial area and the skin and fat widely dissected away from the margin of the sac or thinned out portion of the ab-

FIG. 490.—TRANSPLANTATION OF FASCIA LATA FOR POSTOPERATIVE HERNIA (BARTLETT'S METHOD). The letter H incision on the outside of the thigh.

dominal wall, as in the other operations for hernia. If it is seen that the edges of the ring cannot be brought together without too great tension, the incision is carried no further and the wound is covered with a sterile dressing. With the patient still on her back, the right leg is exposed and flexed in the position shown in Fig. 490. After a thorough skin preparation, preferably with iodin, a long H incision is made in the middle of the lateral aspect of the thigh. The length of the incision depends on the amount of fascia that it is desired to remove. As a rule, a generous flap is necessary, and the incision will occupy the middle three-quarters of the line extending from the great trochanter to the

external condyle of the leg. The cross-incisions at the ends of the longitudinal cut, forming a letter H, enable the surgeon to expose a very wide area of fascia without impairing too much the circulation of the skin-flaps, thus avoiding any possible danger of later necrosis and sloughing. The skin and fat of the thigh are dissected from the fascia lata from the edge of the sartorius in front of the thigh to the edge of the semimembranosus behind. The fascial flap is removed

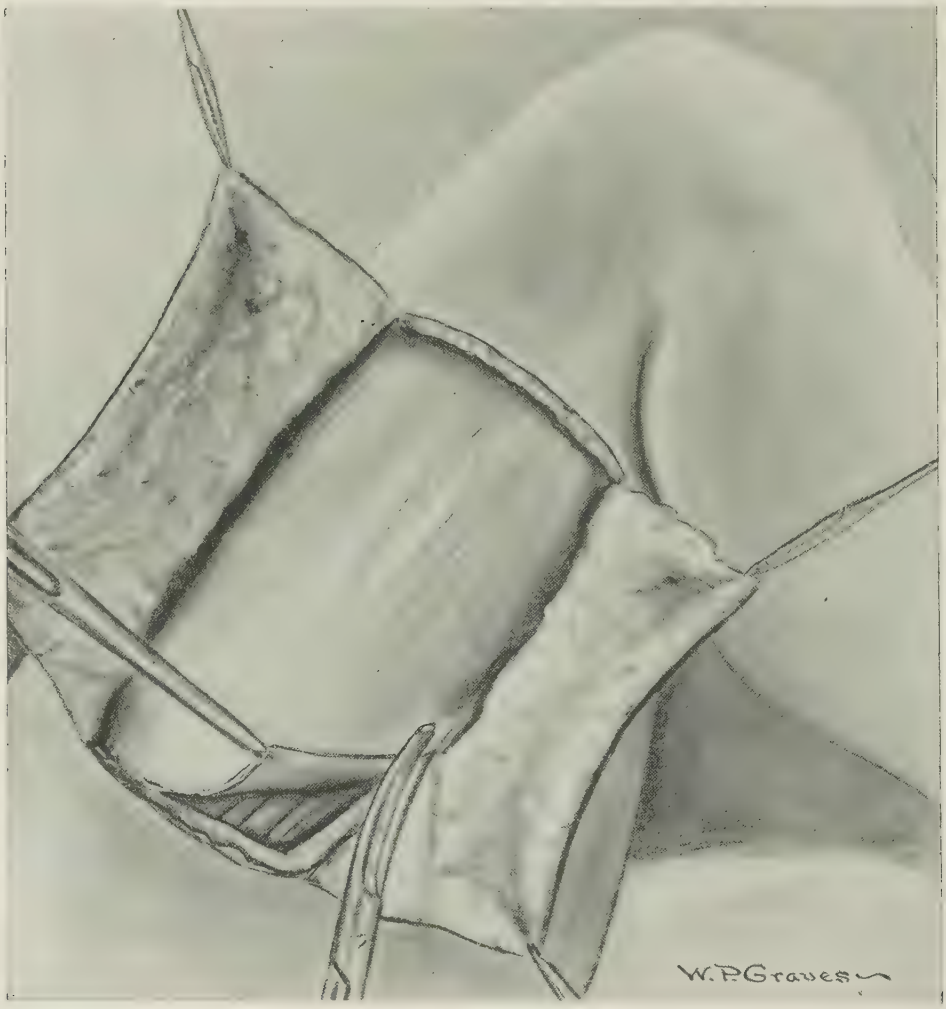


Fig. 491.—Transplantation of Fascia Lata for Postoperative Hernia (Bartlett's Method). Showing method of dissecting fascia from thigh.

in the form of a parallelogram and placed in warm normal salt solution until needed. The wound of the leg is closed.

The abdominal wound is then uncovered. Without making any incision in the fascia the hernial protrusion is inverted and the edges of the turned-in portion sutured with catgut, care being exercised not to pierce the fascia so deeply as to injure a loop of intestine that may be closely adherent beneath.

The flap of fascia lata is removed from the saline solution and cut in the center, the two pieces being sewed together so that the fibers of both pieces in the new parallelogram thus formed will run transversely instead of longitudinally, as in the first piece. A glance at Fig. 492 will explain this point. This maneuver

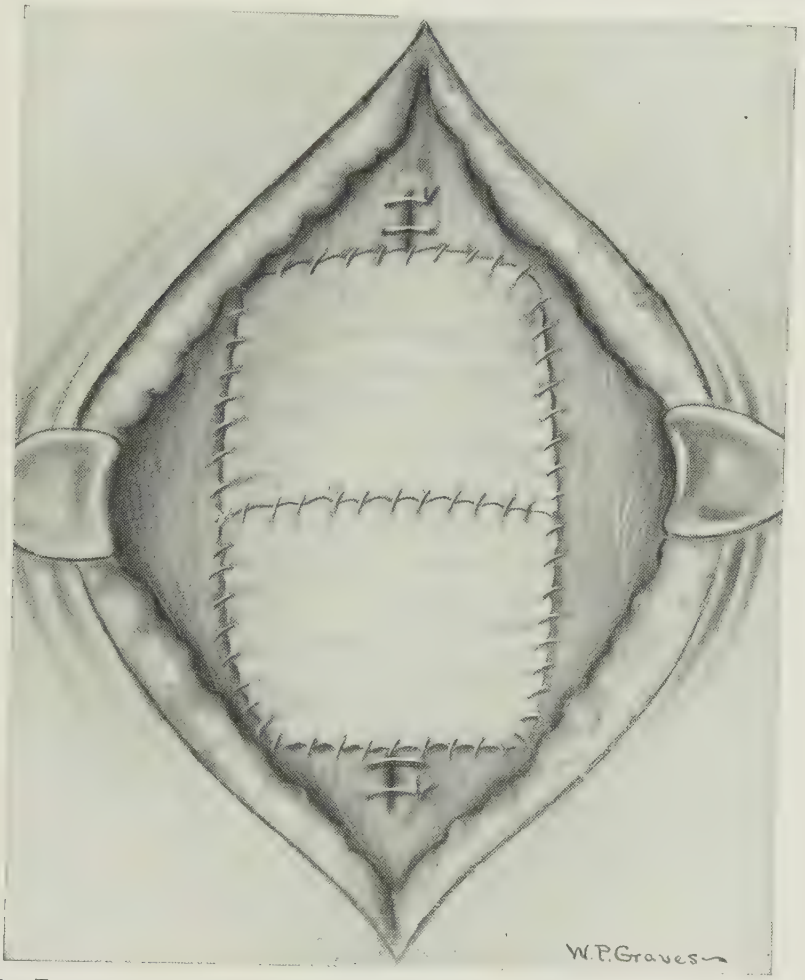


FIG. 492.—TRANSPLANTATION OF FASCIA LATA FOR ABDOMINAL HERNIA (BARTLETT'S METHOD).

The piece of fascia lata removed from the thigh has been cut in two and the pieces laid sidewise so that the direction of the fibers will be at right angles to those of the abdominal fascia. The layer of fascia covering the hernia has been reduplicated by a running suture, the ends of which can be seen above and below the transplanted fascia.

is carried out so that the fibers of the transplanted flap will not coincide in direction with those of the abdominal fascia covering the hernia. The layer of fascia lata is then stitched to the abdominal wall over the inverted hernia (Fig. 492). The wound is closed with a stab-wound drain placed as in Fig. 486. The denuded muscles of the leg become rapidly invested in a new sheath.

Valuable work in fascial transplantation has been done by H. A. Shaw, who epitomizes the essential principles of technic in the following concrete form:

"*Essentials of Fascial Transplantation.*—In selecting a transplant it has been repeatedly demonstrated that tissue which normally is poorly vascularized is much better adapted than highly vascularized tissue. For the first few days the transplant must obtain its chief nourishment from the lymph exudate, supplied by the tissues surrounding, and eventually from the ordinary source due to the vascular connections formed in the new home. Therefore, *the less vascular the transplant and the more vascular the soil, the greater assurance of success.*

"In the selection of tissue for the purpose of transplantation, from a histologic standpoint it seems to be more of a question of vascularization than of any peculiarity or arragement of its cellular constituents, although 'the higher the development of the cell, as ganglion-cell, nerve-cell, muscle-cell, etc., the less likely is it to survive.'

"Therefore in order of their importance would be, first, low normal vascularity, second, simple cellular structure. Fascia to an admirable extent answers both requirements and, in addition, has great tensile strength, which adds materially to its value in a great number of indications. 'It can be transplanted with almost uniform success and is much more sure of success than the ordinary skin graft.'

"Fascial transplants in common with all tissue transplants may be (1) autoplastic (same subject), (2) homoplastic (same species), (3) heteroplastic (another species).

"(1) Autoplastic transplants of fascia lata, when fresh and transplanted under careful technic, are almost as sure to take as normal fascia is to unite after suturing. It is a material that is always available with a minimum amount of injury to the part from which it is obtained and, therefore, either homo- or heteroplasty would have no great advantage even if of equal success. Autoplastic fascial transplants undergo practically no histologic metamorphosis.

"(2) Homoplastic transplants of fascia lata usually take, but undergo histologic change, wherein the elastic tissue is replaced by fibrous, thereby losing one of its most valuable properties under certain conditions, and in this respect preserved autoplastic tissue acts the same as homoplastic. Success of homoplastic flaps probably depends more or less upon the similarity of the blood-serum of the donor and recipient.

"(3) Heteroplastic transplants only act as support for the new formed cells, while the old cells are being resorbed, fibrous tissue usually being substituted for the transplant. Therefore, if the formation of new cells be at least as rapid as the absorption of the old, we obtain a result that would be a clinical success but a histologic failure. Herein enters a great element of chance. Fascia is so easily obtainable in such liberal amounts that heteroplasty should not be resorted to and is mentioned simply to condemn.

"*Technic.*—To insure success in fascial transplantation we should adhere strictly to the following rules:

"(1) *Handle Gently.*—In this respect we should keep constantly in mind the fact the more mechanical injury, the less the vitality of our transplant, and here I would suggest sharp dissection of our transplant at those points where it is intimate with intramuscular septa, thus minimizing trauma.

"(2) *Keep Transplant Moist and Warm.*—I would suggest where practical to prepare your field completely for the reception of the transplant and suture *in situ* immediately. Sometimes this will be impractical. If so, keep transplant in physiologic salt solution at normal temperature. The advantage of immediate suture is the fact that our fascia loses none of its contained lymph by osmosis with salt solution and does not become dry or cold.

"(3) *Keep Free from Antiseptics.*—The same principle applies here as in skin grafting. Therefore do not prepare patient by dry (benzin-iodin) method; do not use iodized gut; allow no possible contact with antiseptics.

"(4) *Transplant Must Come in Close Contact with Tissue and be Maintained in that Position.*—This is important in establishing the future circulation of the transplant, as we can readily see how impossible it would be for our delicately budding embryologic vessels to bridge over any amount of dead space, and how imperfectly maintained contact would disintegrate our

granulating vascular loops. A firmly applied equal pressure bandage is of great service in this respect.

"(5) *Minute Attention to Every Aseptic Detail.*—While infection does not absolutely spell failure, or failure may involve only a limited area of the transplant, yet an aseptic conscience is the first essential of successful fascial transplantation. We fully realize that under normal circumstances the tissues will care for a certain number of micro-organisms, but here we have tissue completely cut off from its normal blood-supply and whose resistance is practically nil; tissue that must derive its immediate nourishment from the surrounding lymph exudate which, if diluted with an inflammatory transudate, would furnish poor nourishment and prevent the intimate contact between the transplant and its new home.

"(6) *Perfect Hemostasis.*—Here again we deal with an interference with proper nutrition and a creator of dead space.

"(7) *Transplant Must be Kept on a Stretch.*—Otherwise it will become shortened and possibly be replaced by fibrous tissue. In other words, it must be placed in as near its physiologic environment as possible. The elastic fibers in fascia lata normally keep it in intimate contact with the muscle, allowing for contraction and expansion. When removed there is a primary contraction due chiefly to the elastic fibers that is complete in a few moments. This is practically overcome by tacking in place immediately upon removal or, better still, by the aid of forceps as recommended by Dr. Guleka."

## OPERATION FOR FEMORAL HERNIA

Femoral hernia is so rare in men and so common in women that it must be classified as a gynecologic disease.

The operation for femoral hernia is usually regarded as a simple procedure, and so it is in many cases. The operation in common use consists in cutting down to the hernial mass, either from an inguinal hernia incision or by a longitudinal incision immediately over the protrusion. The hernial sac is found encased in a mass of fat which often renders the isolation and opening of the sac extremely difficult, especially if, as is frequently the case, the sac is small. When the sac has been found it is freed from the surrounding fat, emptied of its contents, and tied off as high as possible. No attempt is made to close in the ring, as there is no anatomic exposure of the tissues and a blind placing of deep stitches would be ineffectual and dangerous. In the average case the hernial opening is very small, so that recurrence is not common. In many instances, however, the opening is stretched and relaxed, so that the simple tying of the sac without closure of the femoral ring is quite inadequate and may result in recurrence.

An ingenious and effective radical operation for femoral hernia has been presented by Moschowitz and later emphasized and illustrated by Seilig and Tuholske. The principle of the operation involves an approach to the hernia through the inguinal canal. The femoral ring is exposed from behind, the sac emptied of its contents, drawn backward, and tied. The ring is closed by suturing Poupart's ligament to a powerful tendinous band, the so-called Cooper's ligament, which lies posterior to the femoral ring. The details of the operation are as follows:

The incision usually employed for repair of inguinal hernia is made. In order to secure greater exposure this incision may be carried further down toward the pubes, or, if necessity require, it may be extended by a right-angle incision

toward the thigh. The aponeurosis of the external oblique is then divided and the conjoined tendon exposed. The round ligament is isolated and lifted out of the way by a loop of tape. The thin layer of transversalis fascia is incised and the peritoneum brought to view. If the parts be now retracted as in Fig. 493, the neck of the sac as it passes through the femoral ring comes into view. At this point in the operation a knowledge of the anatomy is essential. The crural ring is bounded externally by the external iliac vein, anteriorly by Poupart's ligament, internally by Gimbernat's ligament, and posteriorly by Cooper's ligament. Just beyond the external iliac vein is the deep epigastric artery which may

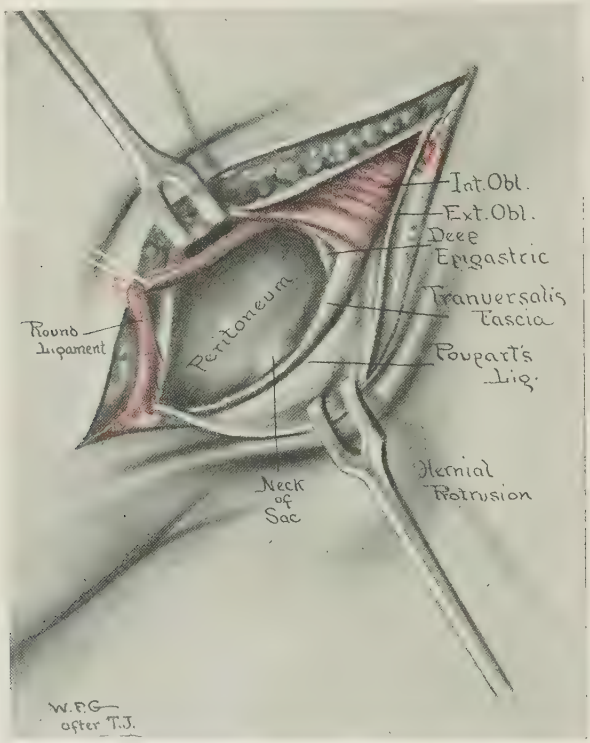


FIG. 493.—OPERATION FOR FEMORAL HERNIA (MOSCHOWITZ).
An inguinal incision has been made and the peritoneum exposed, bringing to view the neck of the hernial sac as it enters the femoral ring.

be encountered in opening the transversalis fascia. It should be remembered that near the edge of Gimbernat's ligament there may run an anomalous obturator artery, the so-called *corona mortis*, the cutting of which is likely to cause serious trouble.

The next step of the operation is to incise the peritoneum near the neck of the sac and to pull the contents of the sac (intestine or omentum) back into the abdominal cavity. Usually the contents are not adherent to the sac. If they are adherent traction on the contents will pull the entire hernial mass through the ring and convert it into an inguinal hernia. If the mass is adherent to the

thigh it may be necessary to extend the incision and dissect out the sac in the usual way.

In case of a strangulated hernia the opening is enlarged by incising Gimbernat's ligament, care being taken not to cut an aberrant obturator artery.

If the contents of the sac are readily drawn back a dressing forceps is then passed through the ring, applied to the wall of the sac and drawn backward, thus bringing the sac into view. The sac is tied off in the usual way as high as possible.

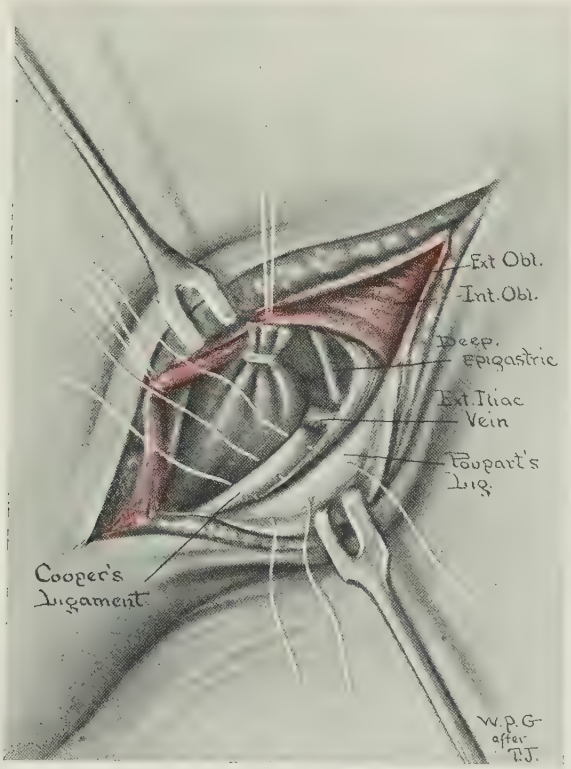


FIG. 494.—OPERATION FOR FEMORAL HERNIA (MOSCHOWITZ).

The peritoneal sac has been opened and the contents of the hernia drawn backward through the femoral ring into the abdominal cavity. The sac has been drawn out, tied, and cut. Cooper's ligament and Poupart's ligament are being united, thus closing the femoral ring.

The next step, which is the most important part of the operation, is the closure of the ring. The parts are fully retracted. Along the horizontal ramus of the pubes and projecting from it is a dense, tough, white, glistening membrane, which is Cooper's ligament. Two or three sutures of chromic catgut are then so placed as to unite Cooper's and Poupart's ligament. The first suture passes deeply through Cooper's ligament just internal to the external iliac vein. It then includes the cut edge of the transversalis fascia and Poupart's ligament (Fig. 494). The other sutures are similarly placed, the innermost one including a bite in Gimbernat's ligament.

The final step of the operation is like that for inguinal hernia. The conjoined tendon is sutured to Poupart's ligament and the aponeurosis of the external oblique, united by an imbricating stitch.

## THE PERCY CAUTERY FOR CANCER OF THE CERVIX

In applying the principles of the Percy cauterization it is necessary to have a special equipment. This consists chiefly of several electric heating irons with an assortment of tips and a water-cooled vaginal speculum (Figs. 449, 450).

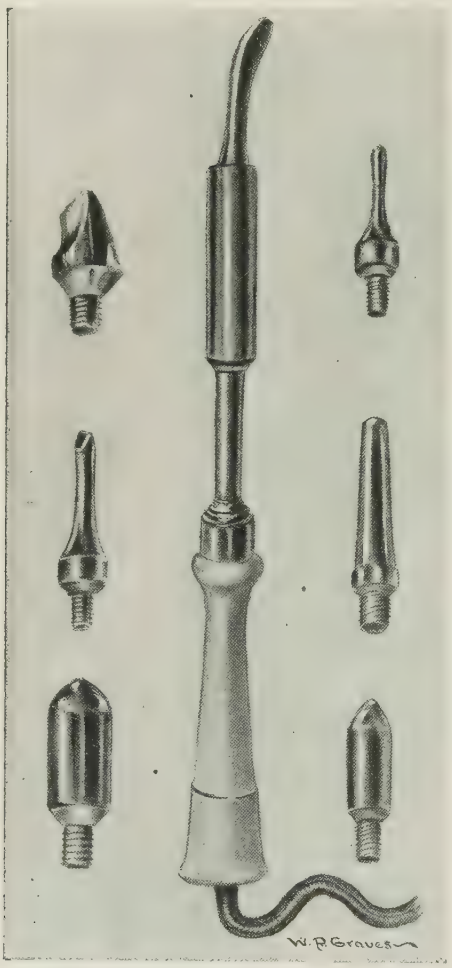


FIG. 495.—PERCY CAUTERY WITH SOME OF THE POINTS WITH WHICH IT IS EQUIPPED.

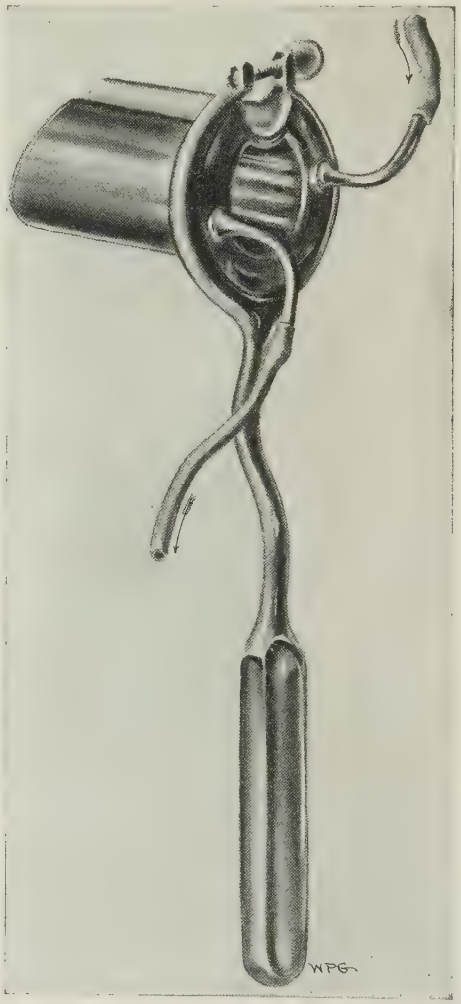


FIG. 496.—WATER-COOLED SPECULUM USED WITH PERCY CAUTERY.

The speculum should be used only when the vagina is sufficiently relaxed to admit the speculum without injuring the mucous membrane.

The patient is prepared for a combined vaginal and abdominal section, the legs being elevated to secure the ordinary perineal posture, while the table is

set in the Trendelenburg position. The abdomen is first opened and the pelvis explored. The intestines are thoroughly packed away. The two internal iliac arteries are tied and the tubes and ovaries removed. This is done in order to check as far as possible the blood-supply to the uterus. Percy regards this as important to avoid the secondary hemorrhages which sometimes follow the use of low degrees of heat. While the abdomen is being opened the vagina is being dilated by a second operator and the water-cooled speculum inserted.

The heating iron is next applied, with the tip adjusted that is most suitable for reaching the diseased area of the particular case. The two operators now

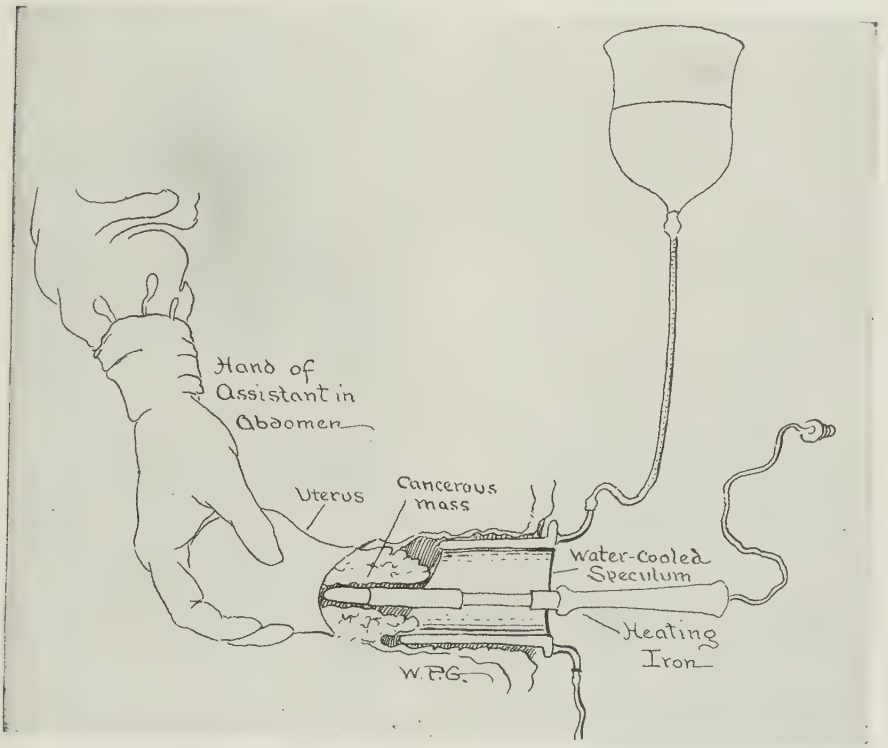


Fig. 497.—The Percy Cautery, Showing Method of Application.

work together. The abdominal operator can by holding the uterus give directions as to how far the heating iron may be inserted, and by downward pressure place the uterus in a more convenient position for applying the heat. The iron is kept at a comparatively low temperature. Percy lays great emphasis on avoiding the charring of the tissues, for once a char is formed it prevents the penetration of the heat into the surrounding tissues. In order to test the amount of heat before inserting the iron it is first applied to wood. If the wood is charred the iron must be regarded as too hot. When the iron has been brought to the required heat it is inserted in the carcinomatous mass. Percy recommends that it always be carried to the fundus of the uterus even if it is necessary to

incise the cervical canal. We have not usually found it feasible to force the entrance as far as the fundus. The length of the application is determined by the abdominal operator who holds the uterus firmly grasped in his gloved hand. The iron is withdrawn when the uterus becomes so hot that the operator can no longer hold it comfortably. The heat attained is from 110° to 120° F. and the time of application to one place from fifteen to twenty minutes. The iron is then shifted to some other point in the diseased tissue and the process repeated. When the treatment is applied to tissues involving the rectum or bladder specially constructed thermometers are used. The whole operation takes from one to two hours.

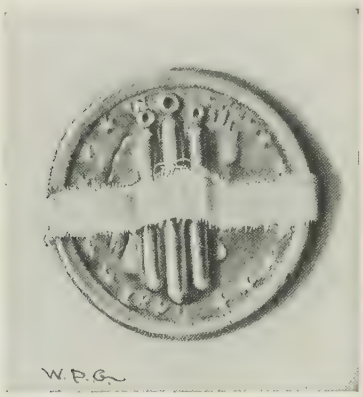


Fig. 498.—Application of Radium.
Method of attaching radium to a silver or gold coin with a strip of adhesive plaster.

Fig. 499.—Application of Radium.
Method of enclosing radium tubes attached to a coin in a rubber cot. The coin and tubes are first wrapped in gauze before insertion into the cot.

## TECHNIC IN THE APPLICATION OF RADIUM

There is at present no standardized technic in applying radium to cancer of the cervix. The methods here described are those employed by the author, and have, for the most part, been adapted or modified from other clinics. They relate only to the direct use of radium salts.

There is no doubt that the radium treatment of cervical cancer is more efficient when the application is made in the form of emanations. Of especial advantage is the use of "seeds" which are planted in the cancerous tissue at intervals of about 1 cm. In this way enormous doses may be given with little danger to the normal tissues. As the emanations are at the

time of writing used chiefly in a few large cancer institutions it seems wise not to attempt a detailed description of the technic of application.

In employing radium in the treatment of cervical cancer the most important consideration is the avoidance of injury to the sound tissues and the prevention of later fistulæ. Too great emphasis cannot be laid on this point.

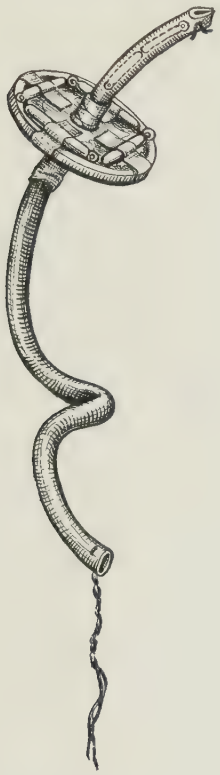

FIG. 500.—METHOD OF APPLYING 200 MGM. OF RADIUM TO CANCER OF THE CERVIX.

Four tubes each of 25 mgm. are strapped on a perforated coin with adhesive plaster. A rubber tube is passed through the opening in the coin and held in place by adhesive plaster. In the short end are placed 2 tubes of 50 mgm. each, the free end being then tightly sewed with strong thread. The coin is covered with a finger-cot perforated at the tip to allow the passage of the short end of the rubber tubing. It is kept in place by an elastic band or by thread as in the preceding drawing. The short end of the tube is slipped into the cervical canal, the apparatus being placed similarly to a stem pessary. The long end of the tube is tucked into the vagina, and the vagina packed tightly with gauze.

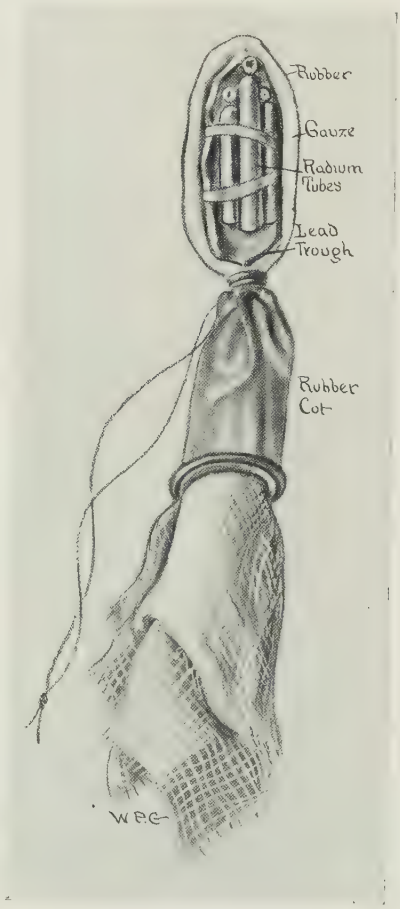


FIG. 501.—APPLICATION OF RADIUM.

Method of attaching radium tubes to a piece of sheet lead, wrapping them in gauze and enclosing the whole in a rubber cot. The upper part of the picture is diagrammatic in order to show how the radium tubes are attached to the piece of sheet lead.

When the cancerous area presents itself as a symmetric growth into the vagina a simple and convenient method of application is that pictured in Figs. 498, 499. In this instance three silver tubes containing radium salts are fas-

tened to a 50-cent piece by a small strip of adhesive plaster. The coin and tubes are wrapped in several layers of gauze and tied in the end of a rubber finger-cot. For the first application it is advisable to anesthetize the patient, for in this way the radium may be much more accurately placed. The vagina, which should be as carefully prepared as for a surgical operation, is widely dilated. If the area

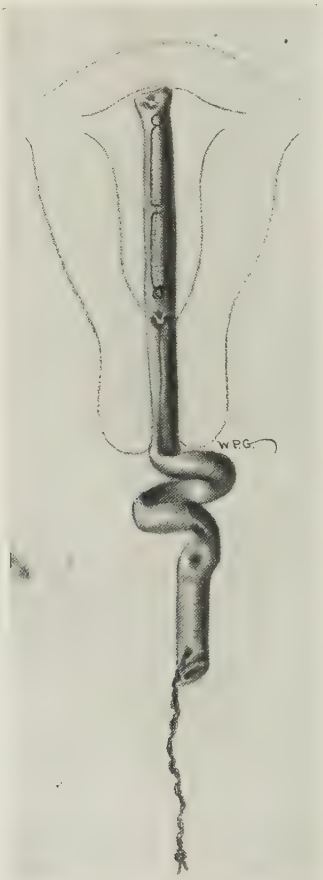


Fig. 502.—Application of Radium.

Method of applying radium to the cavity of the uterus. Two radium tubes are inserted tandem in the end of a long rubber tube. They are sewed in place. The end of the rubber tubing reaches the fundus of the uterus. The other end of the tube is coiled in the vagina and packed against the cervix with gauze. This prevents the rubber tube from slipping down and exposing the cervical canal to the action of the rays.

to be treated is excrescent the vaginal fornices are first packed with gauze folded in a narrow strip. The radium enclosed in the finger-cot is then applied directly against the cancerous area, the tail of the finger-cot extending toward the introitus. The whole vagina is then closely packed with gauze so as to keep the radium firmly pressed against the cancer and to avoid any chance of its slipping from its position. As an additional precaution against injury to the posterior

wall, which is especially susceptible to the destructive rays, we are accustomed to fit a plate cut out of several layers of lead foil wrapped in gauze. The gauze packing of the vagina keeps it in place.

This general principle of application may be modified in many ways to suit the exigencies of the case. When the application is to be made in a cavity or when the radium tubes are to be placed separately in order to secure a cross-fire the tubes may be attached by means of adhesive strips to pieces of sheet lead cut to the required shape and size. They are wrapped in gauze and tied in the end of a rubber finger-cot as shown in Fig. 501. If still greater screening is required, the silver tubes may be left in the brass tubes in which they are kept and both tubes together applied as described above. For further details of treatment see Part II under Radium in the Treatment of Cancer.

When radium is to be used for metropathic cases a convenient technic is as follows: Two tubes of radium are placed "tandem" in the end of a long rubber tube. It is better to place two tubes of 25 mg. in this manner than to use a single tube of 50 mg., because in this way a more uniform application is made to the whole of the endometrial canal. It is usually recommended that black rubber tubing be used rather than the red, as in the latter adventitious rays may be set up. We have had no trouble in this respect, as we have always used the ordinary male rubber catheter. The end of the catheter which contains the eye is cut off and the two tubes firmly sewed in so that they cannot possibly slip one way or the other. The other end of the tube is left long so that when it is coiled up in the vagina it may act as a sort of spring to prevent its becoming dislocated from its position in the uterus.

In applying radium to the uterine canal the patient should always be anesthetized. The end of the rubber tube containing the radium is passed to the fundus of the uterus. The fornices are next packed with a gauze strip. The long end of the rubber tube is then coiled in the vagina and made to press against the cervix by continuing the packing of the vagina with the gauze strip. In this way the radium is prevented from slipping down into the cervical canal notwithstanding the movements of the patient.

The ends of the gauze and of the string attached to the tube should be left near the introitus so that they can be easily extracted. For further information regarding the details of treatment see Part II under the section Radium in the Treatment of Non-malignant Disease.

## OPERATIONS ON THE KIDNEY

In operating on kidneys the incision and proper exposure of the kidney is of the greatest importance, for if this is not properly done the operation may present the greatest technical difficulties. The choice of the incision is dependent upon the magnitude of the operation. For minor procedures, represented especially by nephrorrhaphy and puncture and drainage of an abscess, the kidney can be reached by separation of the muscle layers without splitting or cutting them; while for more extensive operations, when an enlarged kidney must be delivered through the wound, the muscles must be more or less extensively sectioned.

### MINOR OPERATIONS

For minor operations, such as suspension, the following technic, taken from Kelly, is recommended:

The patient is placed in the semiprone position, with an appropriate pad, so as to expose the kidney region as well as possible. One first palpates the

Fig. 503.—Incision for Suspension and Minor Operations on the Kidney.

regional landmarks, which consist of the twelfth rib, the firm outer border of the sacrospinalis muscle, and the crest of the ileum as far as the anterior spine.

The skin incision is started somewhat above the middle of the twelfth rib, and is curved downward and forward toward a point midway between the line

of the spinous processes of the vertebræ and the anterior superior spine, about 3 inches in length. This incision exposes the latissimus dorsi and external

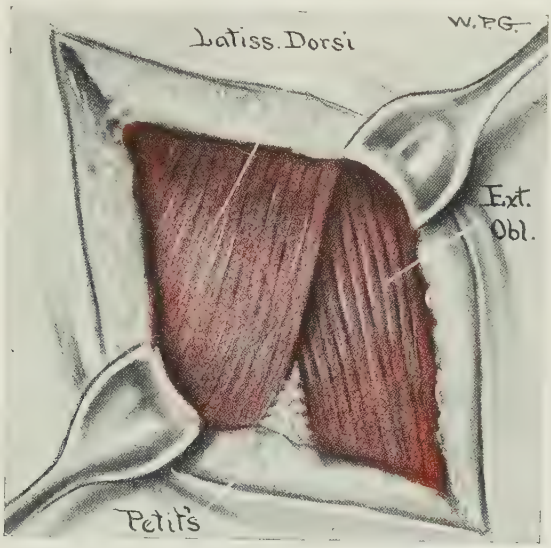


FIG. 504.—SUSPENSION OF KIDNEY.
Exposure of the latissimus dorsi and external oblique muscles and the fat lying in Petit's triangle (adapted from Kelly and Burnam).

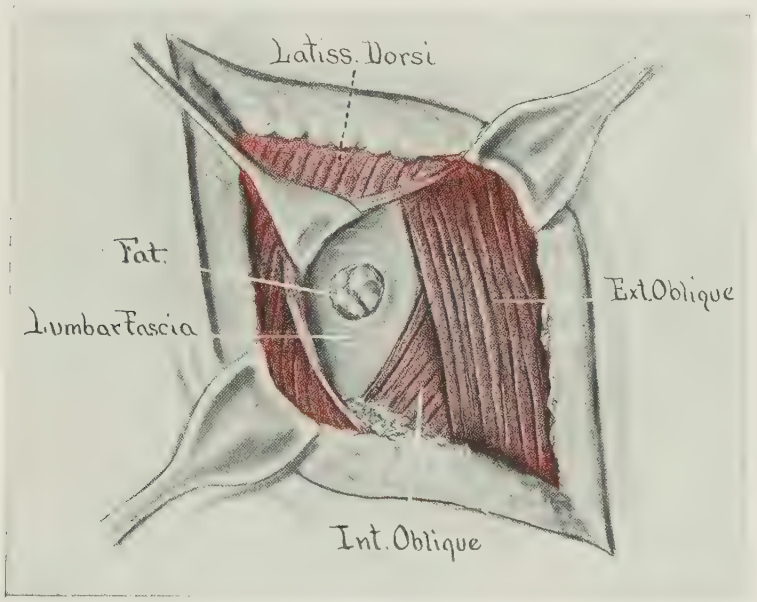


FIG. 505.—SUSPENSION OF KIDNEY.
Retraction of latissimus dorsi muscle, exposing the superior lumbar trigonum. The lumbar fascia has been pierced, allowing the retroperitoneal fat to extrude through the opening.

oblique muscles, the fibers of which meet each other at a slight angle. At the lower edge of the retracted wound the muscles diverge, leaving a small triangular

fascial space—the so-called Petit's triangle; directly opposite this triangle, at the upper edge of the wound, can be felt the tip of the twelfth rib (Fig. 504).

A small retractor is then inserted so as to draw back the edge of the latissimus dorsi. This exposes the lumbar fascia covering the area called the "superior lumbar trigonum." The lumbar fascia is readily separated from the overlying muscles, having only a filmy cellular connection with them. The next step is to perforate the lumbar fascia (Fig. 505). If the border of the latissimus dorsi

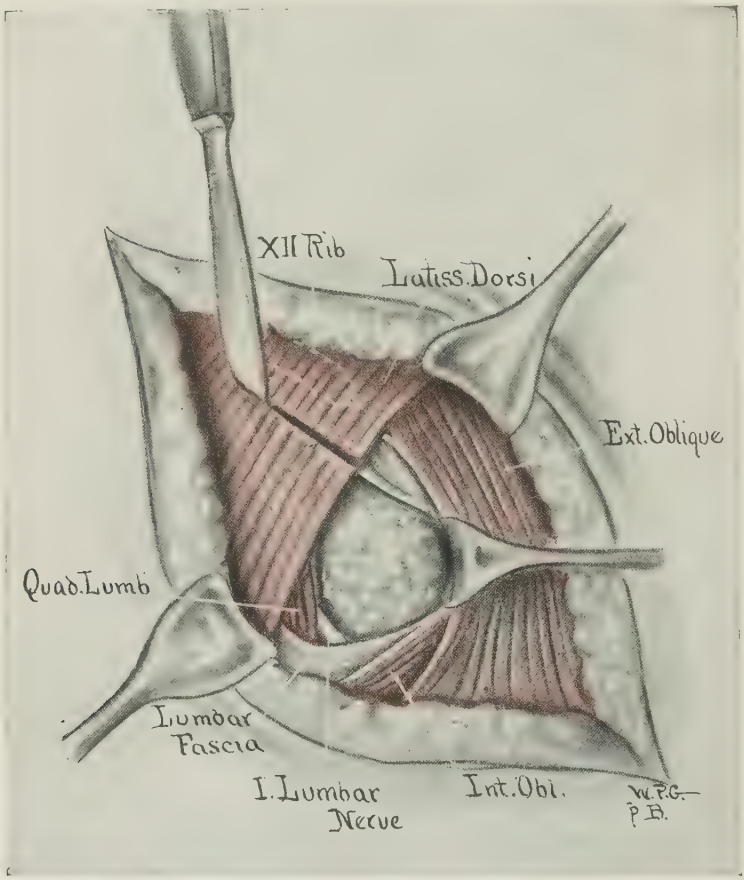


Fig. 506.—Suspension of Kidney.

Transverse incision through the fibers of the latissimus dorsi muscle parallel to the inferior border of the last rib. Used when more room is necessary (adapted from Kelly and Burnam).

muscle extends down too far, as it sometimes does, its fibers may be cut transversely in the direction of the vertebral column.

The opening of the lumbar fascia is now enlarged by inserting two fingers of each hand and exerting strong traction in an up-and-down direction (Fig. 507). By this maneuver, which causes no injury to blood-vessels or nerves, the wound is readily made large enough to insert the hand. The enlargement of the wound brings to view on its inner side the border of the quadratus lum-

borum muscle, under the edge of which, running parallel with its fibers, can always be found the first lumbar nerve. The nerve is seen either as a single or double trunk. It is of great importance to avoid injuring this nerve either by trauma or by including it in stitches.

Along the upper margin of the wound, just under the border of the fascia and running parallel with the twelfth rib, can be seen the twelfth subcostal nerve or one of its branches. At the bottom of the wound made by retraction

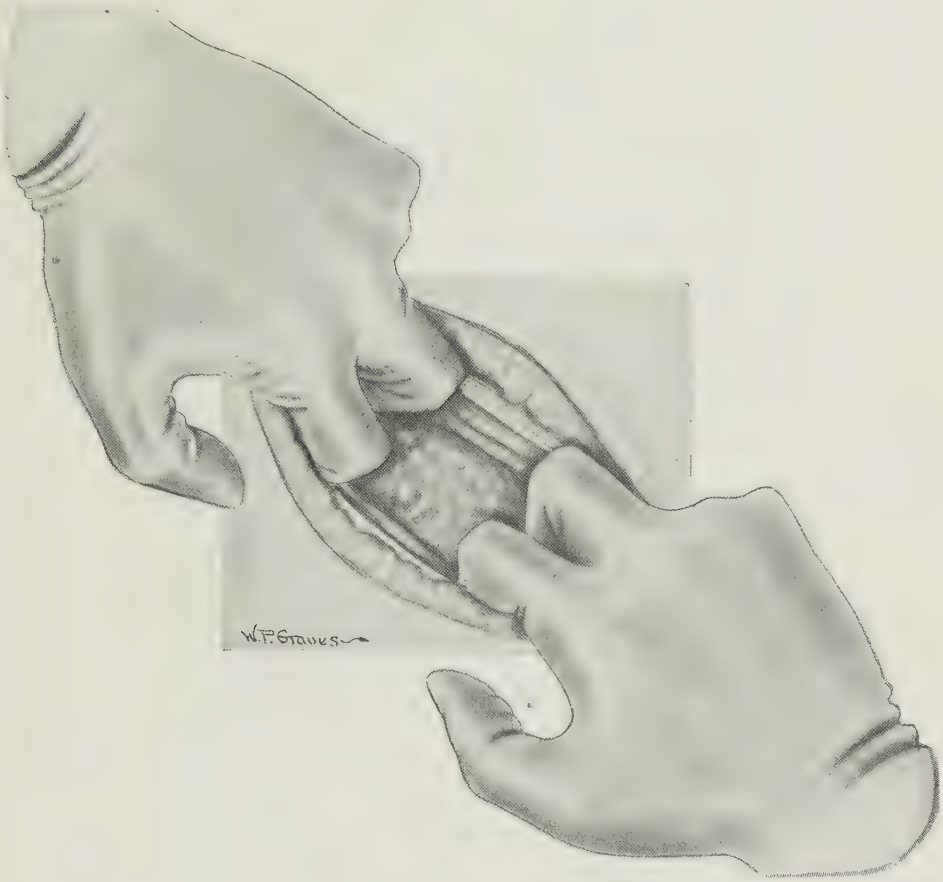

FIG. 507.—SUSPENSION OF KIDNEY.
Enlarging the opening by traction with the fingers.

with the fingers is seen a floor of fat of "orange-yellow color." This fat layer, which varies greatly in thickness in different individuals, is continuous with the retroperitoneal fat of the iliac fossa and anterior abdominal wall.

Between this retroperitoneal layer of fat and the kidney is another layer of fat separated from it by a membrane, the retrorenal fascia (Gerota's capsule). The last-named fat layer closely surrounds the kidney. In order to expose the kidney this layer must be opened. By gradual traction on the fatty capsule

with pressure forceps a movable kidney may be drawn up to the wound. If it is desirable to deliver the kidney, it is best first to separate it entirely from its fatty capsule by the hand. Only a movable kidney can safely be delivered through the incision just described.

### SUSPENSION OF THE KIDNEY (KELLY'S TECHNIC)

The incision is made in the manner described above for minor operations. If the patient has been properly placed on the table, with a pad under the loin,

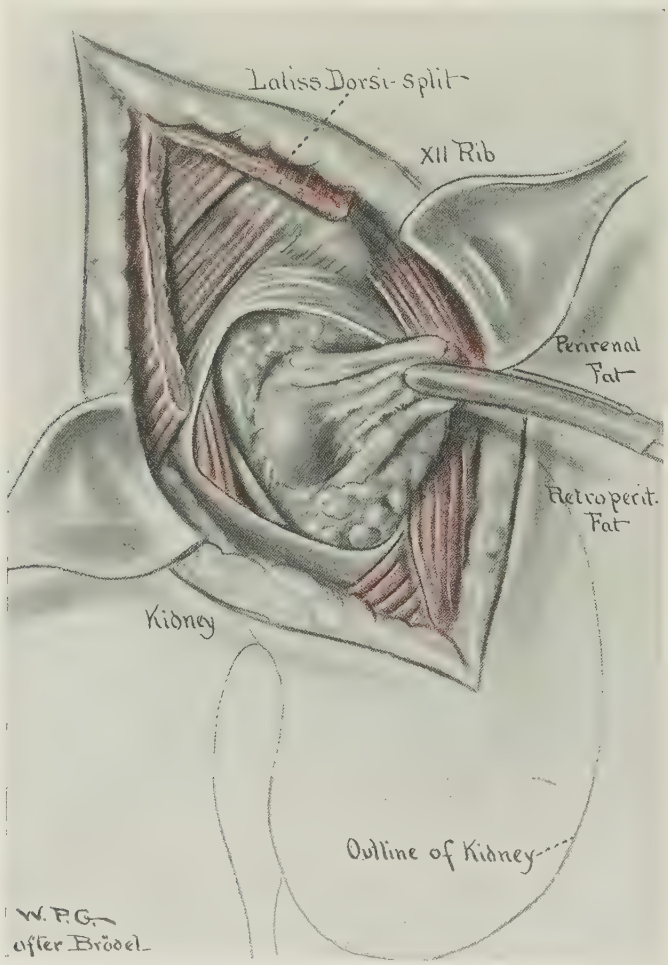


FIG. 508.—SUSPENSION OF KIDNEY.

The latissimus dorsi has been cut transversely. The retroperitoneal fat has been opened and the perirenal fat grasped with forceps. Traction of the perirenal fat has brought the upper pole of the kidney into view (adapted from Kelly and Burnam).

the movable kidney is forced upward under the ribs, so that in bringing it into view it must be drawn downward rather than upward. The kidney is brought

into view by attaching several clamps to the fatty capsule and exerting careful traction so as not to tear the fat. In order to expose a space for the insertion of stitches the capsule is stripped from the posterior surface and upper pole of the kidney.

The kidney, without being delivered, is then thoroughly palpated to discover any incidental abnormality.

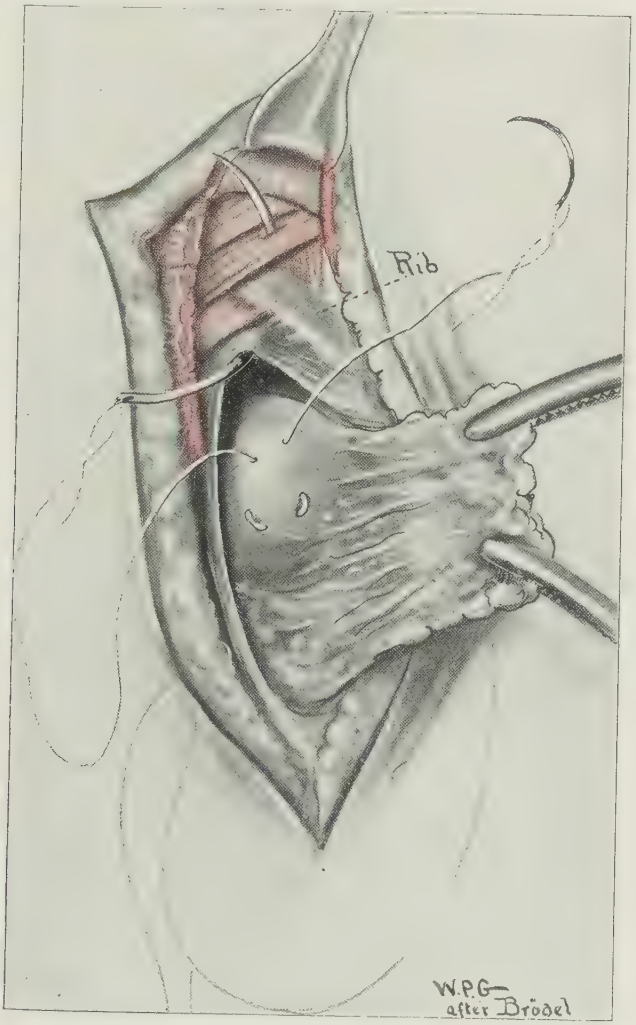


FIG. 509.—SUSPENSION OF KIDNEY.
Introduction of the Brödel suture (adapted from Kelly and Burnam).

In placing the stitches for suspension the object in view is to create an artificial adhesion between the capsule of the kidney and the muscle with which it is to lie in contact. This can best be accomplished with a non-absorbable stitch, either of linen or silk, preferably the latter.

As to the level at which the kidney should be suspended, Kelly advocates

attaching it as high as possible, and our experience substantiates this advice. If the kidney can be made to recede above the twelfth rib the external oblique muscle is strongly retracted or, if necessary, cut, and the tissues dissected back until the twelfth rib is exposed.

Three stitches of fine silk are to be used for suspending the kidney. They are placed in a line along the outer border of the kidney, the upper one at the

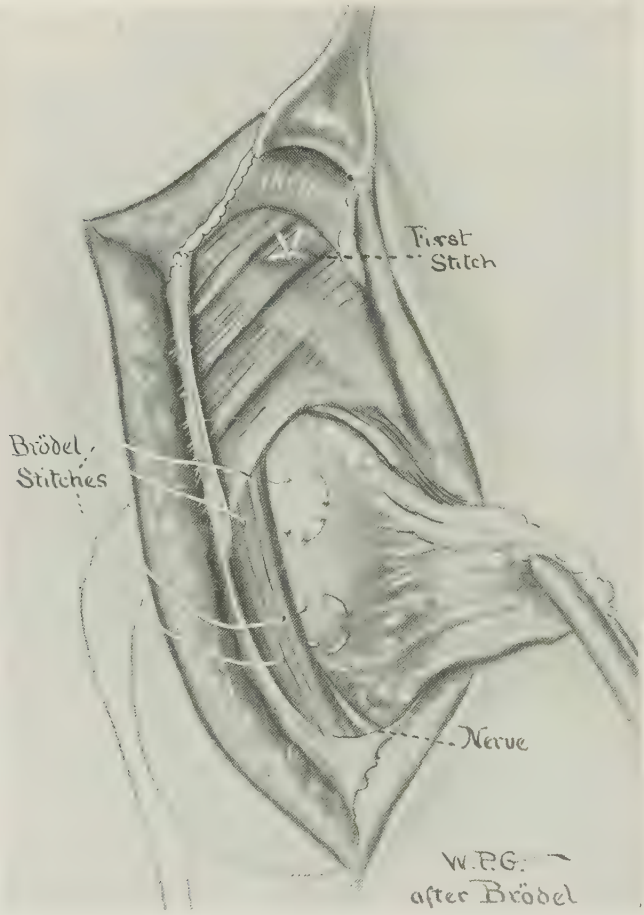


Fig. 510.—Suspension of Kidney.
Placing of the Brödel stitches (adapted from Kelly and Burnam).

junction of the upper and middle thirds, the lower one at the lower pole, and the third halfway between these two. The upper stitch is applied first, and is designed to anchor the upper pole of the kidney to the twelfth rib. The suture is first threaded on a large curved needle, which carries the suture from a point just above the twelfth rib through the wall, emerging in the wound close to the kidney. The needle is then changed to a fine full-curved needle, and the suture in the kidney taken at the junction of the upper and middle thirds. The

manner of applying the stitch was devised by M. Brödel, and consists in plaiting it into the kidney substance at three points of a small triangle, so that a maximum of tensile strength is achieved without danger of lacerating the capsule. The stitch is completed by again threading it on the large needle and carrying it back to a point above the twelfth rib, near that from which it started. The second stitch is passed in a similar manner through the quadratus muscle at the lower pole of the kidney, care being taken not to injure or include the first lumbar nerve which runs just under the lower edge of the muscle. It should always be identified before placing the stitch. The third suture is applied in the quadratus muscle between the two already placed.

In using the Brödel stitch it should not be carried deeply into the kidney substance. Before tying the suspensory sutures care should be taken that any of the fatty capsule intervening between the kidney capsule and the muscle be cleaned away, for its presence prevents the formation of an adequate suspensory adhesion. The redundant fat of the capsule may be removed or stitched to the quadratus muscle. The wound is closed in layers without drainage. If the latissimus dorsi has been cut, its fibers are sewed together.

### INCISION FOR MAJOR OPERATIONS ON THE KIDNEY

When the proposed operation is to involve delivery and removal of the kidney it is of great importance to have a generous opening to avoid embar-

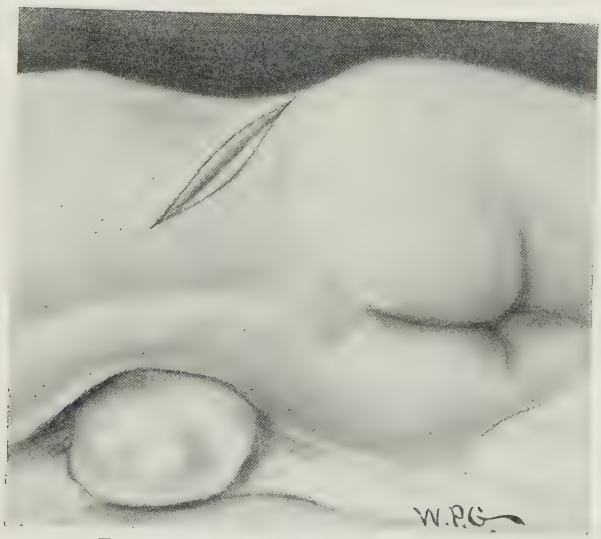


FIG. 511.—NEPHRECTOMY. THE INCISION.

rassing difficulties and dangerous accidents. For this purpose a long incision is necessary. As in making the incision for suspension, one must first determine the location of the twelfth rib, the outer border of the sacrospinalis muscles, and the curve of the iliac crest as far as the anterior superior spine. Within the

angle made by the twelfth rib and the muscle border is an area which is softer to the feel than the surrounding parts, and it is in this area that the incision starts. It is then carried in a curving sweep toward the anterior superior spine, the length of the incision being determined by the magnitude of the operation. The muscular structures covering the kidney may be opened in a variety of ways.

The superior lumbar triangle may be first exposed and a blunt opening of the lumbar fascia made in the manner described for minor operations. This

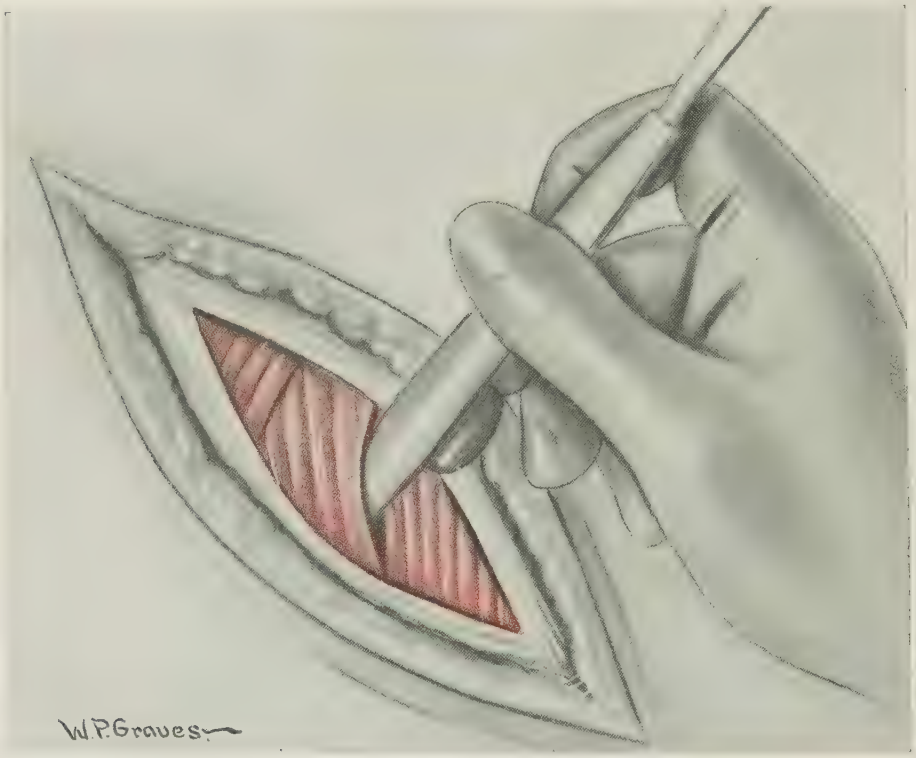


FIG. 512.—NEPHRECTOMY.
The fibers of the external oblique muscle are being divided preparatory to making the "frying pan" incision.

wound may then be greatly enlarged by cutting downward in the direction of the anterior superior spine across the abdominal muscles (external oblique, internal oblique, transversalis) and by cutting upward across the latissimus dorsi and the inferior serratus posticus muscles. Or the muscular structures may be cut before opening the lumbar fascia (Fig. 514).

Still another method is the "frying pan" incision of Kelly. A long skin incision is made. The abdominal muscles are first opened by splitting the fibers, as in McBurney's operation for appendicitis. The wound is stretched with the fingers as in Fig. 507). An incision from this opening is then made

upward through the muscles in the direction of the upper angle of the wound (Fig. 513).

When the lumbar fascia is opened the retroperitoneal fat leaps into view, while at the posterior angle can be seen the border of the quadratus lumborum with the first lumbar nerve (ileohypogastric) skirting along beneath its lower edge. Division of this fat brings one to the thin fascial layer of Gerota's capsule, division

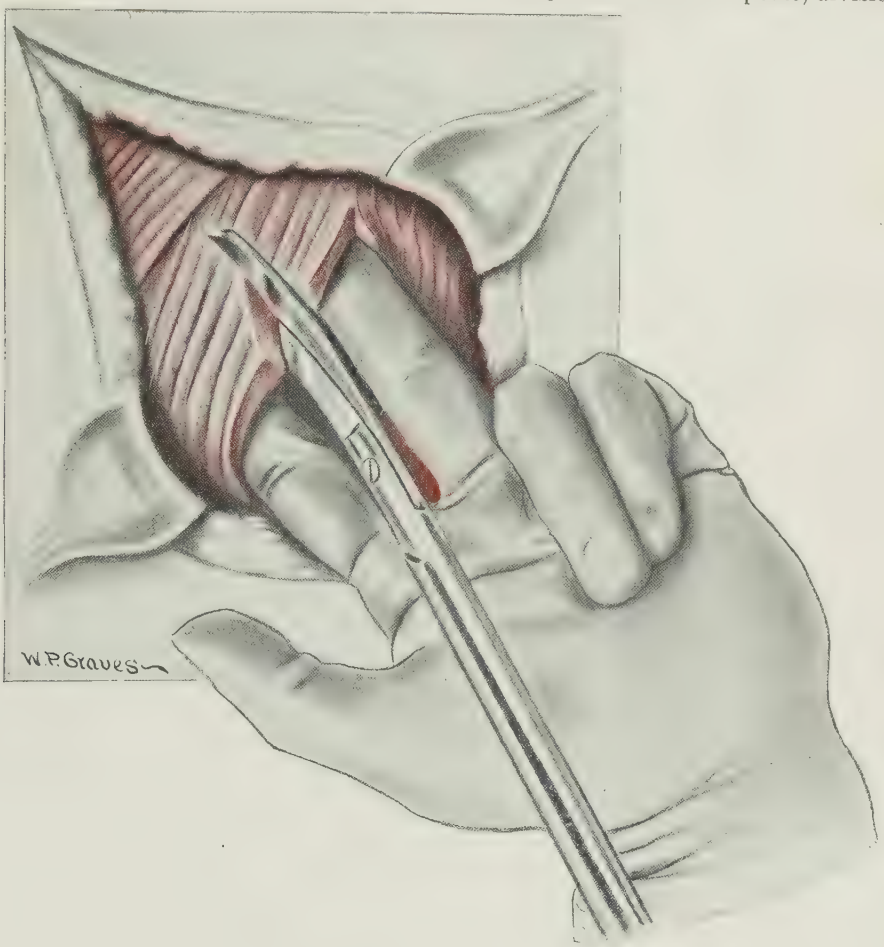


FIG. 513.—KELLY'S "FRYING PAN" INCISION FOR NEPHRECTOMY.

The fibers of the external oblique muscle have been separated. The incision is carried across the muscles to the upper angle of the wound. The underlying layers of muscle are treated in the same way.

of which reveals the lemon-yellow fat of the true fatty capsule of the kidney. It is not always easy to distinguish the two layers of fat and Gerota's capsule. Care should be taken in making the opening through the surrounding layers to avoid entering the peritoneal cavity or injuring the cecum which lies immediately in front of and intimately associated with the outside fat layer. This can be done by keeping well back toward the quadratus muscle.

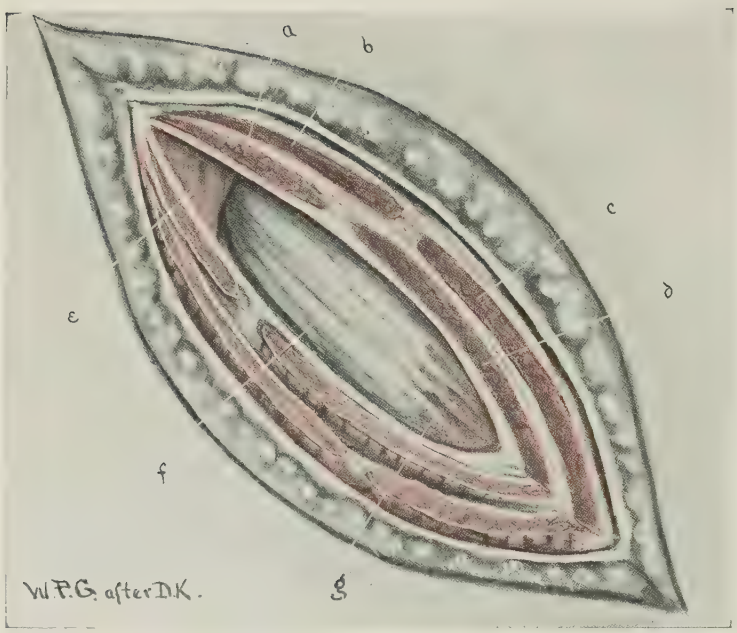


FIG. 514.—NEPHRECTOMY.

Diagram showing the muscles that are divided before opening the lumbar fascia: *a*, Serratus posticus inferior; *b*, latissimus dorsi; *c*, external oblique; *d*, internal oblique; *e*, sacrolumbalis; *f*, lumbar fascia; *g*, transversalis.

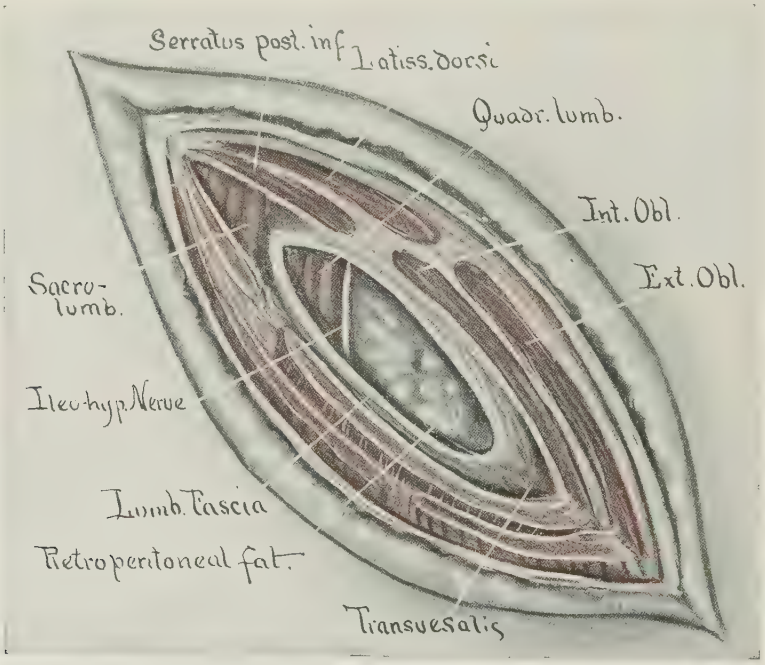


FIG. 515.—NEPHRECTOMY.

Exposure of the fat capsule.

When the fatty capsule has been divided, the firm, smooth surface of the kidney can be felt. Clamps are put on the fat to draw the kidney up toward the wound and facilitate the next step, which is to separate the fatty capsule and deliver the kidney.

The capsule is methodically peeled off by the finger, the anterior and posterior surfaces being first freed with little trouble. In freeing the upper pole the capsule is normally more adherent, and if inflammatory disease is present serious difficulty may be encountered. It is important that the finger be kept

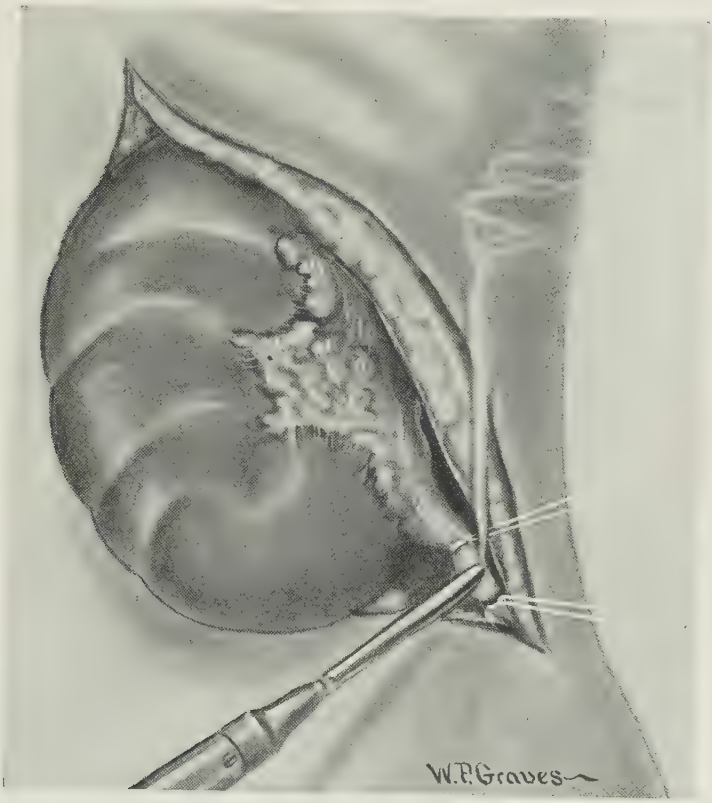


FIG. 516.—NEPHRECTOMY.
Division of the ureter with cautery.

close to the kidney surface in order not to injure the colon or duodenum, which lie in close proximity.

The lower pole is usually easily freed. When the kidney has been thoroughly disengaged from its surrounding capsule of fat the next step is to expose and sever the ureter. The lower pole is first lifted out of the wound, so that the kidney is turned into the position of anteversion (Albarran). This can easily be done if the upper pole has been well freed. By separating the fat in the depth of the wound just below the lower pole the ureter ordinarily comes readily into view. If, however, the ureter cannot at first be found, it is to be

sought *in front* in relation with the peritoneum and not behind near the *psoas muscle.* When the ureter has been found it is stripped of the surrounding fat for a short distance, tied in two places, and severed by the cautery.

When the ureter has been cut, the kidney pelvis must then be developed, and this should be thoroughly done, otherwise a portion of its wall may be included later in clamping the pedicle, the cutting of which may cause spilling of urine in the wound.

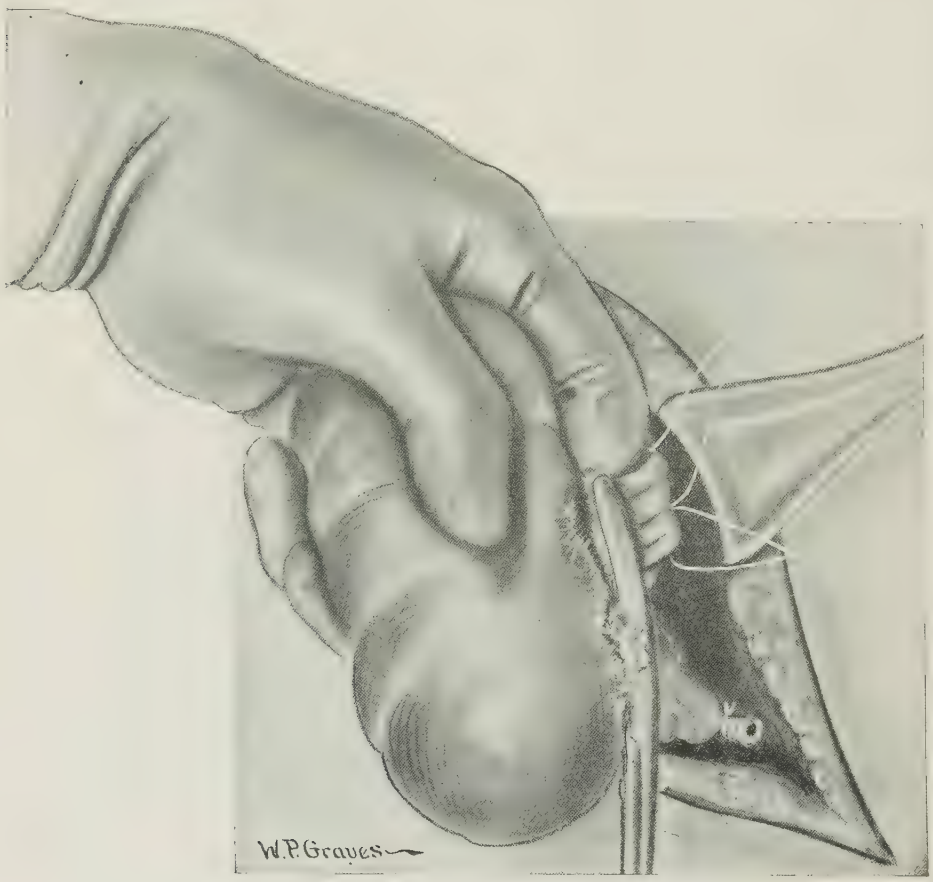


Fig. 517.—Nephrectomy.
Clamping and tying the renal vessels.

After the pelvis has been thoroughly freed, all remaining adhesions of the kidney are released, and the fat about the vessels pushed back so as to expose them more clearly. The kidney is delivered completely from the wound, the forefinger of the left hand bringing into view the pedicle. The pedicle must be tied with the greatest care. A convenient method is to pass a double ligature into the pedicle with a blunt needle. The tension on the kidney is then slackened and the ligatures tied as far away from the kidney as possible. A clamp

is then applied outside of the ligatures and the pedicle cut between the clamp and the kidney. The clamp insures against the retraction of the stump and controls bleeding if the first ligatures were not adequate. It is well now to reinforce the first ligatures by one including the entire stump.

Drainage following nephrectomy depends on the nature of the case and follows the rules for drainage elsewhere.

The wound is sewed in layers, the severed muscle ends being carefully approximated. If the patient is in shock and it is important to save time, the wound can be closed with through-and-through silkworm-gut sutures.

## OPERATIONS ON THE URETERS

To the gynecologist surgery of the ureters is of chief interest in so far as it relates to the repair of injuries done to the ureter during complicated pelvic operations. The ureters are most frequently injured during the extended operations for cancer and during the extirpation of intraligamentous tumors of the uterus or ovaries, which in the process of growth dislocate the ureters from their normal position. The injuries to which the ureters are exposed during these operations are cutting, either partially or completely, ligation with partial or complete obstruction of the lumen, and pressure from clamps, with consequent necrosis and sloughing of the ureteral wall. Another not infrequent injury is the result of stripping the ureter of its blood-supply so that necrosis follows.

Cutting of the ureter is usually recognizable at once and demands immediate attention. The other accidents are often not discovered until later. Ligature of both ureters results in death. Ligature of one ureter may, if the ligature completely and permanently occludes the ureter, often result in cessation of function and atrophy of the corresponding kidney. If the obstruction is incomplete, as is more frequently the case, there is likelihood of hydro- or pyonephrosis, which necessitates a later extirpation of the kidney. If the ureter has been accidentally clamped during the operation, local necrosis is very probable, with extravasation of urine, in which case death ensues unless provisional drainage was established at the time of the operation. Sloughing of the ureter results in fistula through the vagina if there is drainage. The same may be said of necrosis caused by stripping the ureter of its blood-supply.

When the ureter has been cut during an operation the surgeon has before him four procedures from which to choose: (1) Uretero-ureterostomy (or ureterocystostomy); (2) extirpation of the kidney; (3) ligation of the proximal end of the ureter; (4) establishment of a ureteral fistula.

(1) **Uretero-ureterostomy.**—When the injury of the ureter has taken place at such a distance from the bladder that the proximal end cannot be conveniently implanted in the bladder wall, an anastomosis between the severed ends of the ureter is indicated. This is best accomplished by implanting the proximal end of the ureter into the side of the distal end. The distal end is first firmly tied. In the side is then made a longitudinal slit large enough to admit freely the other end of the ureter. A fine linen or catgut suture, threaded on a fine rounded needle, is placed as depicted in Fig. 518. It first enters the distal portion of the ureter from without inward at a point just below the lower end of the slit. It then is carried to the proximal end of the ureter and enters the wall from within outward at a short distance from the end. Entering the proximal and

distal walls in the reverse direction, it emerges close to the point from which it was started. With the aid of this suture the proximal end of the ureter is drawn into the slit made in the distal portion and anchored there by tying the suture. Another suture of fine linen fastens the posterior side of the entering portion of the ureter to the upper angle of the slit. In order to make the union more secure two or three more sutures may be taken around the line of junction.

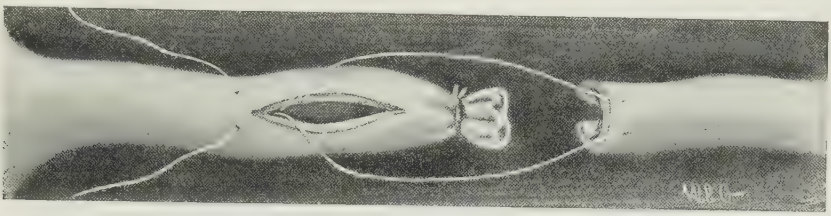

FIG. 518.—URETERAL ANASTOMOSIS (END TO SIDE).

The distal end of the ureter is tied and a longitudinal incision made in the wall near the tied end. The manner of placing the principal suture is shown (magnified for purposes of illustration).

The end-to-side anastomosis just described is the best method if the ends of the cut ureter are long enough to admit of the manipulation without too much traction and without too much interference with the ureteral blood-supply. When the ends are too short for the previous operation an end-to-end anastomosis may be performed in the manner shown in Fig. 520. The distal end is incised a short distance in order that it may admit the end of the other portion. A guiding stitch is placed in the same manner as in the previous operation, and the union of the two ends made secure by interrupted sutures

FIG. 519.—URETERAL ANASTOMOSIS (END TO SIDE).

Operation completed.

of fine linen. It is probable that this form of anastomosis is less secure than the one first described, and is also more likely to result in stricture of the canal.

When either of these operations has been done, provisional drainage should be established in case of leakage. This can in most cases be done through the vagina. The drain should be as small as possible, encased in rubber, and *never in contact with the ureteral wound.* It should be so placed that if leakage does occur it will find a path of least resistance to the drain. The drainage, of course, is subperitoneal.

**Ureterocystanastomosis.**—When the lesion of the ureter occurs near enough to the bladder to allow the proximal end to be easily approximated to the bladder, implantation in the bladder wall is indicated. The implantation can be done intraperitoneally or extraperitoneally, the latter being far preferable.

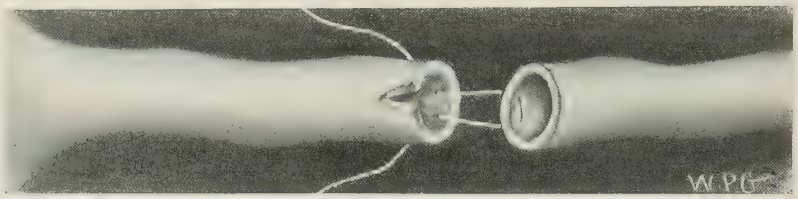

FIG. 520.—URETERAL ANASTOMOSIS (END TO END).
Manner of placing the principal suture.

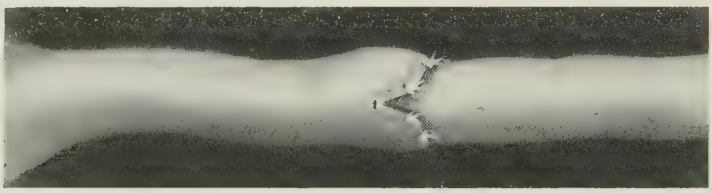

FIG. 521.—URETERAL ANASTOMOSIS (END TO END).
Operation completed.

This is usually a very simple matter, for the portion of the bladder nearest the point of injury has been denuded of peritoneum during the process of the main operation.

FIG. 522.—URETEROVESICAL TRANSPLANTATION.
Showing method of slitting up the end of the ureter and placing the sutures.

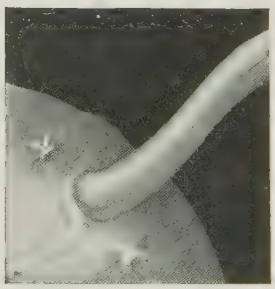

FIG. 523.—URETEROCYSTANASTOMOSIS.
Operation completed (diagrammatic).

The operation devised by Sampson is the simplest and most effective. A small slit is made in the end of the ureter. In the wall of the bladder is made a small incision large enough to admit the end of the ureter. The making of this

incision is facilitated by having an assistant insert a catheter into the bladder through the urethra, so that the end of the catheter may be used as a point of counter-resistance. Sutures of fine linen or catgut are then placed in the two lips of the ureteral end and the bladder in the way shown in Fig. 522. The placing of these sutures is made easier by threading a needle on each end. The split end of the ureter is drawn into the bladder by traction on the two sutures. The sutures are then tied. If the opening in the bladder has been made somewhat too large, a few fine sutures may be applied in order to make the joint secure.

Krönig has still further simplified Sampson's operation by sewing only one of the lips of the split end of the ureter into the bladder wall. He reports 23 successful cases out of 25.

### EXTIRPATION OF THE KIDNEY

One can imagine cases in which anastomosis of the ureter is impossible after injuring the ureter. One of the alternatives open to the surgeon is nephrectomy. This can be done transperitoneally through the same wound made for the pelvic operation, though it may have to be enlarged upward somewhat. The condition of the other kidney is first determined and all possible doubt of its proper function excluded. In performing the operation the colon is pushed toward the median line and an incision made through the parietal peritoneum. The perirenal fat capsule is divided and cleared away to gain complete exposure of the renal vessels, pelvis, and ureter. The ureter is then divided, the pelvis lifted from its bed, and the renal vessels developed and tied with as long a pedicle as possible.

Extirpation of a normal kidney through an abdominal wound is not a difficult operation; nevertheless, it should not be undertaken unless the patient is in excellent condition or unless the main operation has not been prolonged. As neither of these conditions usually prevail at the end of a difficult operation for uterine cancer, in which operation the ureter is most commonly injured, immediate nephrectomy is a procedure which is not often resorted to.

### LIGATION OF THE PROXIMAL END OF THE URETER

When the injury to the ureter is such that anastomosis is out of the question and nephrectomy is too grave an operation to be considered, the proximal end of the ureter may be tied, on the chance that the corresponding kidney will cease to functionate and become atrophied. This should, of course, not be done if there is any doubt regarding the integrity of the opposite kidney.

The success of this maneuver depends to a considerable extent on the fate of the ligature applied to the ureter. If it cuts into the ureteral wall it may cause a fistula, or if it becomes infected, ascending infection of the kidney will ensue, in either of which cases a nephrectomy will eventually be required.

If, however, great care is exercised in closing the end of the ureter a successful outcome may be expected.

In a case operated on by the author the left ureter was involved in a colossal adherent cystic myoma of the uterus, so that it had to be resected above the brim of the pelvis and at its entrance into the bladder. The proximal end of the ureter was carefully tied and sutured over. The patient had complete suppression of urine for thirty-six hours, when she began to secrete urine, and from then on made an uneventful recovery. The right kidney underwent a compensatory hypertrophy which could be felt on palpation several years after the operation. The patient was in perfect health.

### FORMATION OF URETERAL FISTULA

When the ureter has been injured so that anastomosis is impossible and the opposite kidney is in any way incompetent, the only course left for the surgeon is to establish a fistula by carrying the ureter through the muscle layers of the back and attaching it at an opening in the skin. Fortunately, it is only extremely rare that the combination of circumstances would make this undesirable operation necessary.

Implantation of the ureter in the colon is also an operation to be avoided if possible, as it almost inevitably results in an ascending infection of the kidney.

## OPERATIONS ON THE BLADDER

### SUPRAPUBIC CYSTOTOMY

In opening the bladder from above the technic described by Kelly is recommended. The patient is preferably under complete anesthesia. A catheter is first introduced into the bladder and the bladder thoroughly washed out. The catheter is left in the bladder for the later introduction of air. A transverse or longitudinal incision is made just above the pubes, the fascia divided, and the recti muscles held apart. The suprapubic retroperitoneal space is now cleared by dissection with the fingers, care being taken not to rupture the peritoneum. An assistant then attaches a sterilized Davidson syringe to the catheter and pumps air into the bladder until it balloons up into the suprapubic wound. The bladder wall is caught either by two sutures or by two fine Allis' clamps to serve as tractors. The bladder wall is freed by blunt dissection, which pushes the peritoneum further back out of harm's way, care being taken not to strip the bladder wall over an unnecessary area.

The bladder is opened by an incision made transversely or longitudinally between the two tractors. When the opening through the mucosa is made the air escapes and the bladder collapses. The patient is then placed in the Trendelenburg position, the bladder being now well exposed for whatever operation is intended.

In closing the wound a fine chromic catgut stitch is used, carried through the vesical wall down to the mucosa. Two or three layers should be used so as to invert the wound toward the bladder. Especial care should be taken in uniting the fibrous fascia layer of the outer vesical wall.

The recti muscles, fascia, and skin are approximated in the usual way. Kelly recommends leaving a small drain in the wound of the abdominal wall.

### VAGINAL CYSTOSTOMY

In severe cases of chronic cystitis, especially those due to tuberculosis or long-continued irritation from stone, opening of the bladder and drainage through the vagina gives immense relief. Dudley's technic in performing this operation is first to distend the bladder with water, the patient being under general anesthesia in the dorsal position. A pair of curved artery forceps is introduced into the bladder and the ends separated. An incision is then made between them into the bladder (Fig. 524), care being taken not to cut the structures at the neck of the bladder. The incision is $\frac{3}{4}$ to 1 inch long and should be large

enough to insure competent drainage. There need be no fear that there will be later trouble in closing the fistula. The chief difficulty is in keeping these fistulas open, and for that reason the additional precaution must be taken after making the incision of sewing the bladder mucosa to the vaginal mucous membrane. If, after the lapse of time, it becomes desirable to close the wound, and it is still open, an ordinary vesicovaginal operation is practically

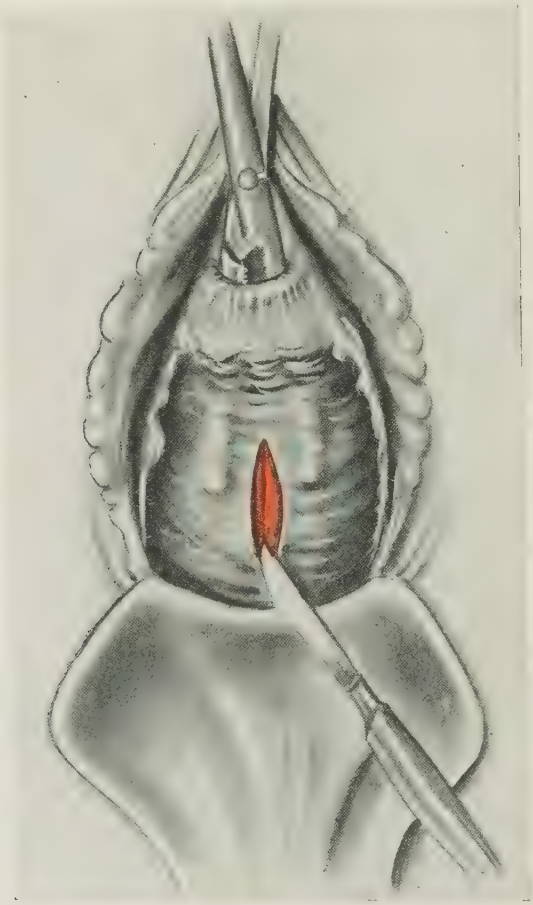

Fig. 524.—Vaginal Cystostomy.

A pair of half-length curved clamps is introduced into the bladder through the urethra and partly opened. An incision is made through the vaginal and bladder walls between the ends of the clamps (adapted from Kelly and Burnam).

sure to be successful. In this case the conditions differ from the fistulas that follow childbirth in which the vesicovaginal septum has suffered a loss of tissue, so that the operation of closure is hampered by the tension of the wound edges.

In nullipara, in whom the perineum acts as an obstruction to full drainage, Kelly recommends enlarging the introitus by incising the peritoneum and sewing the vaginal mucous membrane to the skin transversely, as in Fig. 336.

# OPERATIONS ON THE RECTUM

## PROLAPSE OF THE RECTUM

The treatment of prolapse of the rectum depends on whether the condition is one merely of prolapse of the mucous membrane, such as is frequently seen in children, or whether it is a so-called true prolapse in which all the layers of the rectal wall are involved.

When the prolapse is of the mucous membrane only, conservative measures should be employed as far as possible. Many of these cases, especially in children, are the result of inflammation of the rectal mucosa, and can be cured by local applications to treat the catarrh. Mechanical supports are sometimes efficacious, as are also electricity and massage by the Thure Brand method.

Of operative measures for treating true prolapse there are a great number, a few of which may be mentioned. The canal may be narrowed by longitudinal resections of the mucous membrane with suture of the wounds. This is also done by resecting the coccyx, and through the opening thus made the rectal wall is infolded longitudinally and then attached to the sacrum (Marchant). The rectum may be suspended in another and simpler way: A transverse incision is made posterior to the anus. Through this incision the posterior wall of the rectum is separated from its attachments toward the coccyx and sacrum. With the finger in the rectum, the posterior wall can be delivered through the opening behind the anus, ready for the application of sutures. Several non-absorbable sutures (preferably silkworm-gut) are then passed through the skin on one side of the sacrum into the wall of the rectum, and then out past the other side of the sacrum. The sutures are introduced into the rectum where it is delivered through the incision, so that there is no danger of carrying them too far into the wall. When the sutures are tied over the sacrum the slack wall of the rectum is drawn strongly upward and attached to the sacrum. The transverse incision is closed with the exception of a small rubber drain. The silkworm-gut sutures are removed in about ten days. We have used this operation with success, but in one case the convalescence was delayed by troublesome sepsis in the wound. The operation is Tuttle's modification of Ekehorn's method.

Other methods of suspension of the rectum are carried out by the abdominal route. Most of these procedures are based on the principle of suspending the rectum or sigmoid to the anterior abdominal wall, a procedure that is very objectionable from a surgical standpoint.

The most logical abdominal operation for prolapse is that devised by Moschowitz, who proceeds on the interesting and reasonable theory that true rectal

prolapse is a sliding hernia. On account of the adherence of the peritoneum to the anterior wall of the rectum there is no peritoneal sac as in other hernias. The sliding process takes place first in the *anterior* wall of the rectum which is free, the posterior wall being intimately attached to the pelvis. Complete prolapse of the entire circumference of the gut takes place only in late stages of the

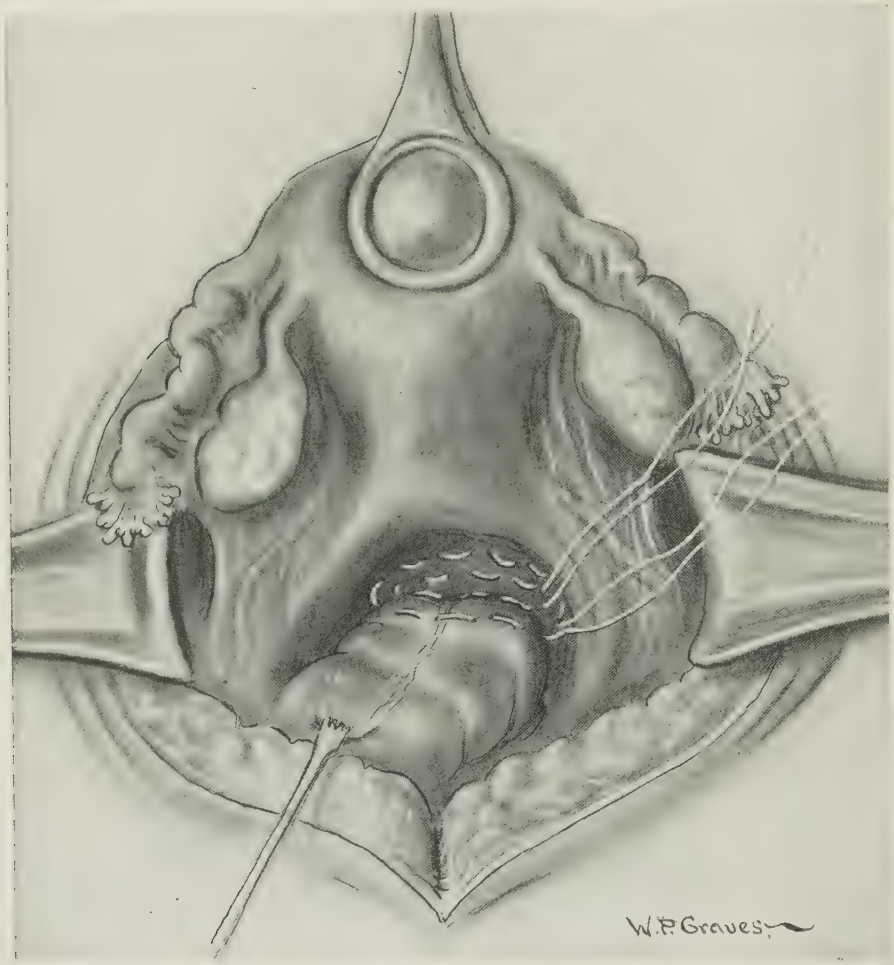


Fig. 525.—Moschowitz's Operation for Prolapse of the Rectum.

The uterus and rectum are drawn upward toward the wound, exposing Douglas' fossa. Purse-string sutures are introduced around the circumference of the fossa beginning at the deepest part. Only two sutures are shown in the drawing. Five or six are usually required to complete the operation. When the stitches are drawn taut the fossa is completely obliterated.

disease. In most cases, therefore, only the anterior wall is found involved. The pouch of Douglas naturally follows this prolapse, and for this reason loops of intestine are frequently found in the hernial protrusion.

The technic of Moschowitz's operation is as follows: A long median incision, with the patient in extreme Trendelenburg position. The culdesac of Douglas is always found unusually deep. The rectum is pulled up and held taut. Linen

or silk sutures are now passed circularly around the culdesac of Douglas, the lowest suture being placed about 1 inch above the lowest point of the pouch. About five or six sutures are placed one above the other, so that when drawn taut they completely obliterate the culdesac.

When the sutures reach the region of the supravaginal portion of the cervix and body of the uterus they include the muscular tissue of these structures. It is important to avoid injuring the ureters and the internal iliac vessels.

The after-treatment is the same as that of any pelvic operation. The bowels are left to move of themselves.

## HEMORRHOIDS

The three principal surgical procedures for the treatment of hemorrhoids are Allingham's dissection and ligation of the hemorrhoidal artery, Whitehead's radical removal of the hemorrhoidal tissue, and the clamp and cautery operation.

By far the most rational and useful of these operations is the method of dissection and ligation. With the patient in the perineal position, the sphincter is first thoroughly but not injudiciously dilated (Fig. 526). The hemorrhoids are thus brought prominently into view. The most conspicuous ones are then removed in the following manner:

The most salient part of the hemorrhoid is seized with an artery clamp and lifted up. The mucous membrane over the hemorrhoid is incised by a narrow oval incision, including the part seized by the clamp and running in a radiating direction with reference to the anus (Fig. 527).

When the incision through the membrane has been made, the pile is still further freed with a few snips of the scissors until the pedicle containing the artery is reached. This is tied with fine catgut, leaving the pedicle rather long (Fig. 528). It is important not to remove too much of the mucous membrane on each side of the clamp. After the removal of the hemorrhoid the edges of the wound fall together. We are accustomed to approximate these edges with a few fine catgut stitches. Some regard this as unnecessary. The other hemorrhoids are then treated in the same way. Nothing but an external sterile dressing is needed. In a severe case the bowels are kept closed for nine days; in a mild case, four or five days.

If gas is troublesome, a very fine rubber or silver tube may be inserted and left for several hours each day. The bowels may be moved by oil catharsis and enema.

**Whitehead's Operation.**—The method of radical removal of the entire hemorrhoidal area should not be used as a routine measure, but reserved only for those severe cases where the hemorrhoids appear in a great annular prolapsed mass about the anus and the individual piles are scarcely distinguishable. Since the operation was announced numerous technics have been described. We are accustomed to perform the operation in the following way:

Patient in the perineal position. The sphincter is well dilated. Four points are taken in the mucous membrane of the bowel at a level just behind its junction with the anal membrane. At these points sutures with long ends are placed, to be used for the purpose of traction and holding the bowel in

Fig. 526.—Operation for Hemorrhoids.
Stretching the sphincter.

position for further manipulation. The incision for the removal of the annular mass is now outlined for one-fourth or one-half the circumference, the outer incision being at the junction of skin and anal membrane, and the inner being at the junction of the anal membrane and that of the bowel. Care must be taken not to carry the incision too far out on the skin, nor too far in on the

mucous membrane, in either of which cases serious contractions may later develop.

The hemorrhoidal mass is then removed by knife or scissors over the distance marked out. Hemorrhage is stopped by deep ligation and not by the

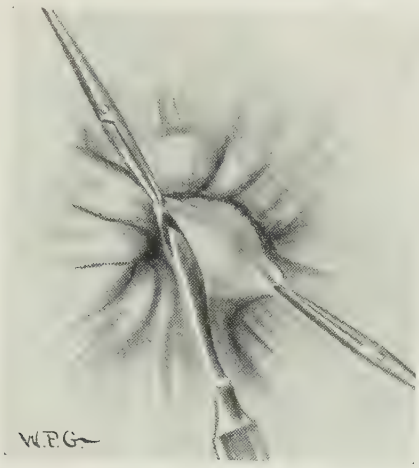


FIG. 527.—LIGATION OF HEMORRHOIDS.
The hemorrhoid has been grasped and brought to view by fine pressure forceps. The hemorrhoid is dissected by knife or scissors.

sutures that approximate the skin and mucous membrane. When the hemorrhage has been controlled the skin and mucous membrane are united with fine

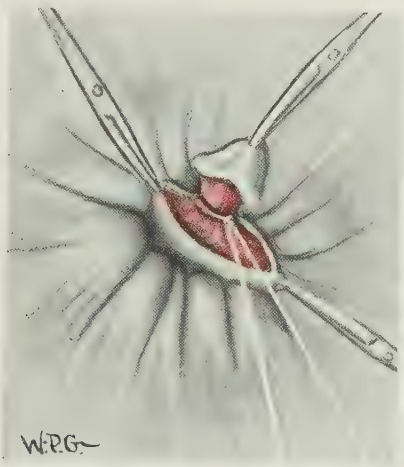


FIG. 528.—LIGATION OF HEMORRHOIDS.
The hemorrhoid has been dissected out and its pedicle is being tied. The wound may be closed with a fine catgut suture or it may be left without suture, the edges falling together naturally in good coaptation.

catgut sutures. When the section of the operation first outlined has been completed, another section is treated in the same way. It often happens that the

skin is very redundant as a result of old external hemorrhoids. In this case there is too much skin to match the corresponding edge of mucous membrane. This difficulty is easily obviated by cutting wedge-shaped pieces from the redundant skin-flap and sewing the wedge edges with fine catgut. With a little ingenuity the skin-flap can be made to fit the mucous membrane exactly.

The method described is at first tedious, but after a few trials can be done rapidly.

A sterile dressing is applied to the anus. The bowels are kept closed for several days. If swelling occurs, it is relieved by applications of hot salt solution.

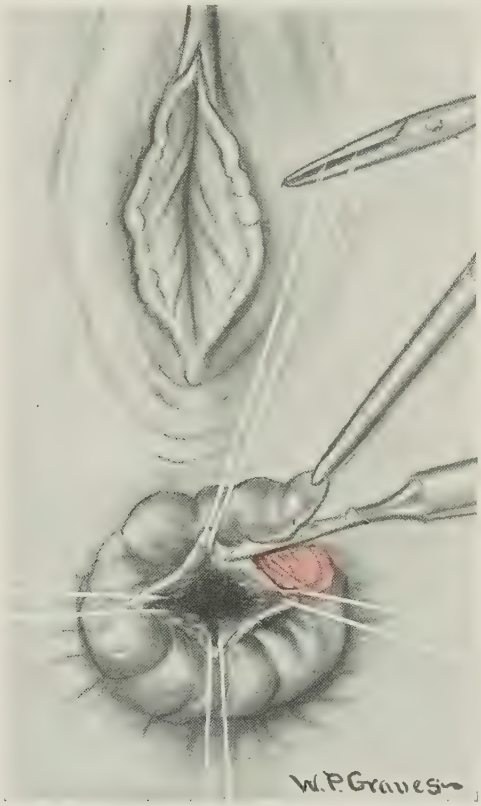


FIG. 529.—WHITEHEAD'S OPERATION FOR HEMORRHOIDS.

Four guide sutures have been placed in the rectal mucous membrane to bring it down into view. The circular ring of hemorrhoids is being dissected off with knife or scissors, care being taken to make the wound edges smooth and even and not to carry the dissection too far out on the skin.

**Clamp and Cautery.**—In our practice the clamp and cautery method of treating hemorrhoids has been given up in favor of dissection and ligature, because of the greater frequency of postoperative fissure and of the higher percentage of recurrence in the former method.

The operation is as follows: Dilatation of the sphincter, with the patient in the perineal position. The most conspicuous hemorrhoid is seized by an artery

forceps at its most salient point and lifted up. A special crushing-clamp is then applied including the entire pile, but not implicating the skin or mucous membrane of the bowel. It is of much importance that the clamp be adjusted to the pile in such a way that it has a radial direction with reference to the circumference of the anus. This is to insure the approximation of the wound edges. When the clamp has been properly adjusted and applied so as to crush

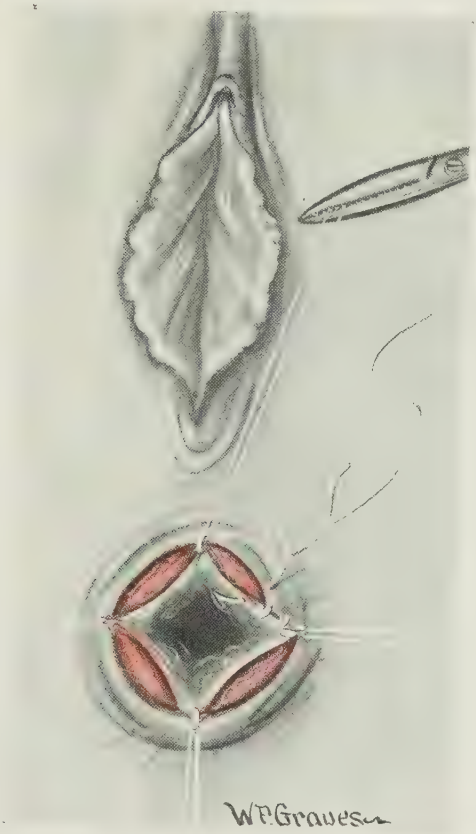


FIG. 530.—WHITEHEAD'S OPERATION FOR HEMORRHOIDS.

The ring of hemorrhoids has been dissected off. The mucous membrane of the rectum is being sewed to the circular wound edge of the skin. It is convenient to place four sutures first as in the drawing. If the skin is redundant at any point a wedge-shaped piece may be cut from the skin. In this way the wound edge of the skin may be made to fit exactly that of the mucous membrane.

the artery supplying the hemorrhoid, the portion of the pile projecting above the plane of the clamp is burned off with the actual cautery kept at a moderate dull-red heat. In this way the principal hemorrhoids are removed. There is more danger from postoperative hemorrhage after this operation than from the other two methods described. The after-treatment should be the same and as long continued after this operation as after the others.

## FISTULA IN ANO

The surgical treatment of fistula in ano consists either of incision of the tract and open treatment of the wound, or of dissection of the fistulous tract with partial closure and drainage of the wound.

By the first method a director is passed through the fistulous opening and out through the anal orifice (Fig. 531). The tissues are then slit with a sharp knife carried along the groove of the director. In this way a part of the sphincter muscle is always cut. This may do no harm if only the external fibers are cut. If, however, the internal fibers are severed, fecal incontinence is likely to follow.

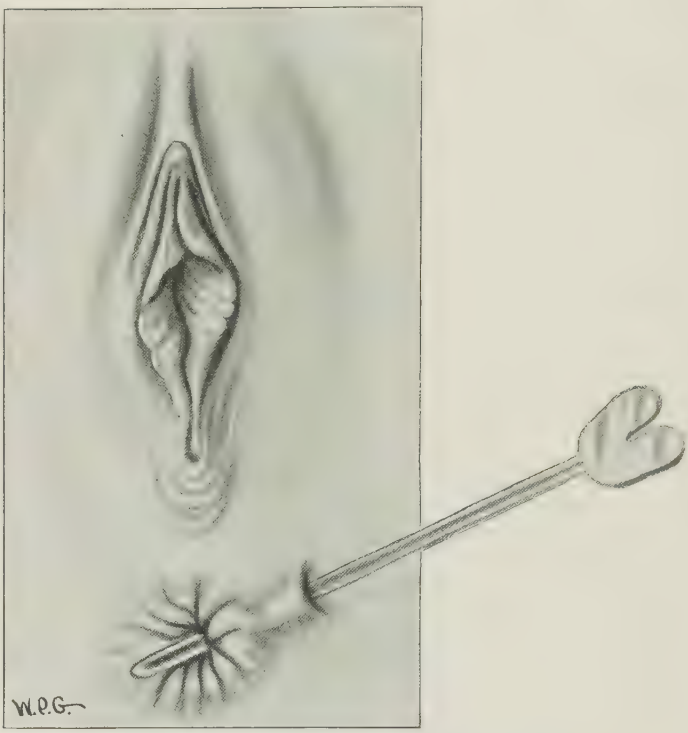


FIG. 531.—FISTULA IN ANO. OPEN METHOD OF OPERATION.

A director is introduced into the fistulous tract and an incision made along the director. The open wound is packed and allowed to granulate. In making the incision, fibers of the sphincter muscle are severed to a greater or less extent.

The wound is packed and kept open with iodoform gauze for a week or so, when it is allowed to heal. In some cases the open method just described is the only one feasible, especially in those cases where the surrounding tissue is undermined and unhealthy.

In the majority of cases seen in gynecologic clinics the dissection method is entirely feasible and preferable. The author's technic is as follows:

The fistulous tract is first explored with a fine probe to determine its direction, whether it is simple or complex, and whether or not it communicates with

lumen of the bowel. A director is then introduced, being brought out through the anal orifice if there is a definite opening. If no opening is found, no attempt is made to force it through. With the director in place, an incision is made as shown in Fig. 532.

It is on the principle of the so-called "apron" incision for complete tear of the sphincter originally devised by J. C. Warren, and is designed to protect the wound as much as possible from contamination from the anal orifice.

A semicircular incision is made through the skin outside the border of the anus. At right angles to this an incision is made to the fistulous opening along the course of the director. On reaching the fistulous opening the incision

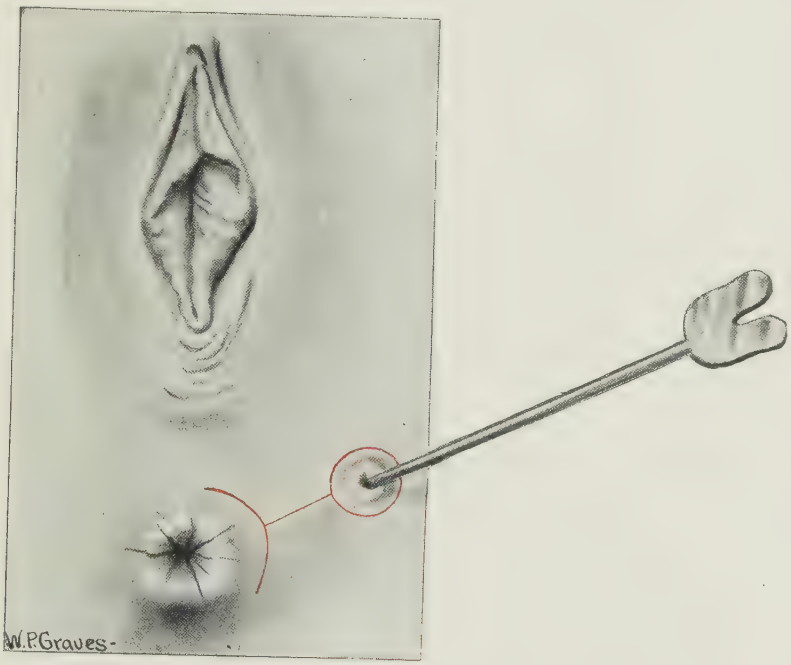


Fig. 532.—Operation for Fistula in Ano (Author's Method).
Dissection of the tract. A director is introduced into the fistulous opening. The red line indicates the line of incision.

encircles it with a margin of about $\frac{1}{4}$ inch. Through the incision thus outlined the fistula is now dissected out as a tube surrounding the director (Fig. 533). In order to keep the fistula tense for the purpose of dissection it is seized at its end with a pair of toothed clamps, by which it can be held in a convenient position; the dissection is then carried to the end of the fistula. If there are ramifications of the fistulous tract, these are also dissected out. As little damage is done to the fibers of the sphincter muscle as possible, it being unnecessary sometimes to cut them at all.

If the fistula has entered the lumen of the bowel the opening is first closed with fine catgut sutures applied from the wound side. If the sphincter has been

injured, fine catgut sutures are placed in such a manner as best to unite the lacerated fibers, the figure-of-8 stitch being especially useful in accomplishing this result. When the dead space left by the removal of the fistula has been, for the most part, closed, a small drain of folded rubber tissue is placed in the bed of the wound and led out through a stab-wound to one side and below the level of the operation. The wound is closed with deeply placed silkworm-gut

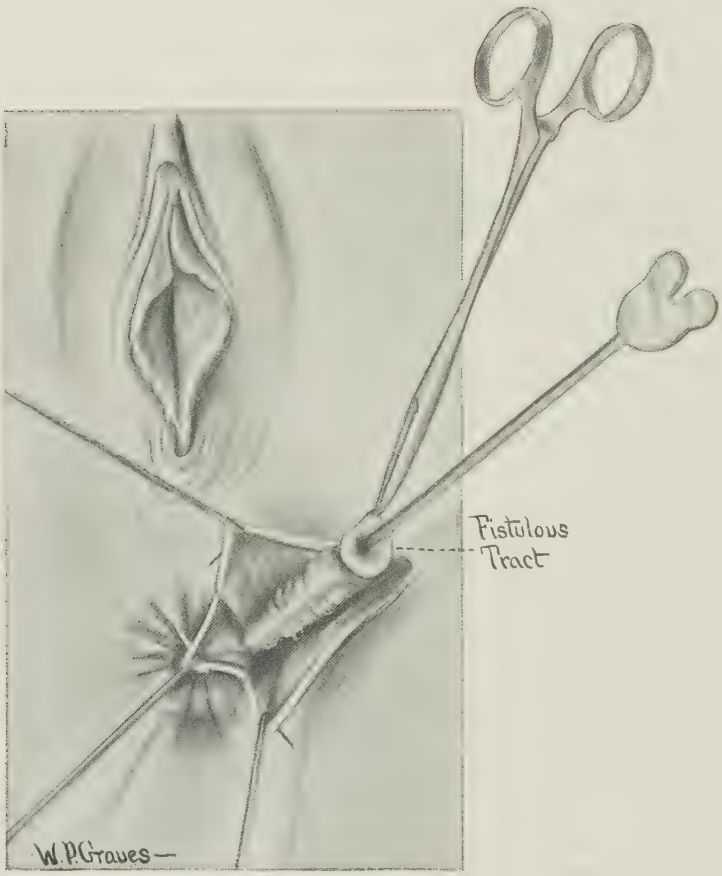


Fig. 533.—Operation for Fistula in Ano (Author's Method).

The fistulous tract has been dissected down to its entrance into the rectal canal. During the dissection the director is kept in to serve as a guide. The fistulous tube made by the dissection is kept taut by a pressure forceps attached to the tissue about the opening.

sutures which are shotted. Any inequalities in the approximation of the wound are smoothed over with superficial stitches of fine catgut, a matter of considerable importance for preventing the entrance into the wound of contaminating organisms.

The silkworm-gut stitches are removed on the ninth day, and on the following day the patient's bowels are moved for the first time by oil catharsis and enema. The small drain is removed on the third day.

The results of this operation in the author's hands have been excellent, the percentage of delayed convalescence and discouraging recurrence being much less than after the employment of other methods. One of the chief advantages

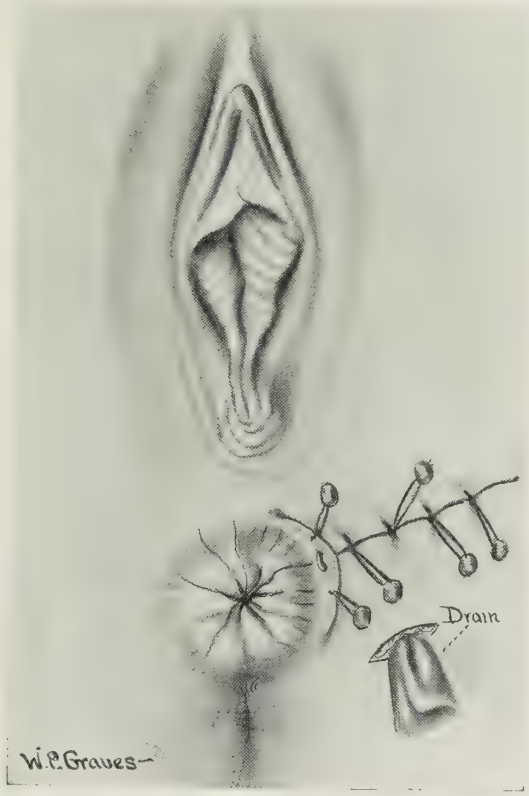


FIG. 534.—OPERATION FOR FISTULA IN ANO (AUTHOR'S METHOD).

The fistulous tract has been dissected out. A few buried approximating stitches of fine catgut have been applied to any severed fibers of the sphincter muscle. The wound is closed by silkworm-gut sutures the ends of which are shotted. A small rubber drain is placed from the cavity of the wound through a stab-wound below the main incision.

of the operation is that the sphincter muscle receives a minimum of damage, and if it is seriously injured it can be repaired at the time of the operation.

### ELTING'S OPERATION FOR FISTULA IN ANO

The sphincters are first thoroughly dilated. The general direction of the sinus or sinuses is first investigated with a fine probe through the external opening. A circumcision is then made about the anus at the point where the mucosa of the bowel joins the skin, as in the Whitehead operation for hemorrhoids. The mucous membrane of the bowel is dissected upward well above the internal opening of the fistula if it can be demonstrated. If such an opening cannot be seen, the dissection is carried to the "white line," which indicates the

insertion into the rectum of the levator ani muscle. By this dissection all connection of the bowel with the fistulous tract is severed. The external opening or openings are then dilated and the fistulous tract in all its ramifications thoroughly cureted, care being taken not to injure the sphincter muscle. The free margin of bowel made by the first dissection is now trimmed off above the level of the internal fistulous opening, and the edge of the upper segment of bowel united to the skin of the anus by interrupted sutures of fine silk or catgut, as in the Whitehead operation for hemorrhoids. The external fistulous opening is lightly packed with gauze. The bowels are moved in two days. The external openings heal gradually by granulation.

## TECHNIC

*Author's Note.*—In writing the following section the author realizes the wide divergence of opinion that exists among gynecologists in regard to many matters of technical detail. The methods here described are those in use at the present time at the Brookline Free Hospital for Women and are the result of many years of trial and comparison with other methods. To the experienced gynecologist who has worked out his own technic the section may be of little interest. To the beginner it is offered either for imitation or as a groundwork from which an individual technic may be developed. Many of the instructions contained in this section have already been mentioned throughout the book in discussing the treatment of the various gynecologic diseases.

### EXAMINATION OF THE PATIENT

Pelvic examination in the office should be made only in the presence of an attending nurse or a female friend of the patient, preferably a relative. The patient is first instructed to empty her bladder, and then to loosen her clothing about the waist and to remove her corsets. The nurse arranges the patient on the table with a sheet draped over the knees, the abdomen being exposed so that it may be inspected and palpated. It is inadvisable to cover the face, as pain and tenderness can best be detected by watching the facial expression.

In the examination of a gynecologic patient the attention should first be directed to the abdomen. Its contour will give evidence of large tumors, abnormal fat, hernia formation, ascites, accumulation of gas, etc. Undue laxity of the abdominal muscles with diastasis is frequently noticeable at the first glance.

Palpation of the abdomen must be undertaken with the utmost gentleness and delicacy of touch. The first point for examination should always be the uterine region immediately above the pubes. If the fundus of the uterus can be felt it may be assumed that some abnormality is present, the conditions which produce this sign being most commonly pregnancy, myoma, or a tumor in the posterior culdesac which presses the uterus forward into anteposition. The ovarian regions are then palpated, at first gently, then firmly and deeply, for the discovery of possible adnexal tumors, and to elicit tenderness if pelvic inflammation is present.

Attention is next directed to the abdominal rectus muscles, with special reference to undue rigidity or laxness. If rigidity and tenderness are present, it must be determined whether the muscular spasm is general, or whether it is confined to or more marked in one muscle, or whether it is localized in a certain area, as in the pelvis, the appendix region, the epigastrium, etc. In determining muscular spasm of the abdominal recti it is of the very greatest importance to distinguish between voluntary and involuntary muscle contractions. Many patients from fear, resentment, or lack of nervous control will

hold the abdominal muscles in a continuous state of rigid contraction, which makes the abdominal examination difficult and confusing.

Relaxation of the abdominal wall with diastasis is usually quite apparent from inspection and palpation. It is made more evident by asking the patient to cough, or still better by raising the patient's shoulders a few inches from the table, when the recti are brought into firm contraction. Umbilical and post-operative hernias are brought into prominent view in this way.

Every abdominal examination should include as a routine careful palpation of the regions of the appendix, gall-bladder, liver, stomach, kidneys, and colon, even if the symptoms do not call particular attention to these organs.

If abdominal enlargement is discovered, one must first determine whether or not it is due to fat, to intestinal distention, or to ascites. If a pelvic tumor is definitely made out the final diagnosis of its nature must usually be deferred until the vaginal examination is made.

When all possible information has been gained from palpation of the abdomen, the vaginal examination is undertaken.

The external genitals and anus are first inspected under a good light. Abnormal conditions made evident by inspection are genital atrophy, abnormal secretions, urethral caruncle, enlargement of Skene's and Bartholin's glands, skin lesions of the vulva, procidentia, relaxation of the vaginal outlet, hemorrhoids, etc. If the outlet is relaxed the amount of prolapse of the vaginal wall is best determined by placing the forefingers of the two hands in the two lateral sulci of the torn perineum and pressing firmly downward toward the buttocks. When the patient is requested to strain as in the act of defecation the anterior and posterior walls of the vagina roll outward and show distinctly the amount of cystocele and rectocele present.

Digital examination by vagina is first made with the left forefinger, which should be well lubricated. The best lubricants are made from glycerin and sea-moss. If one of these preparations cannot be had, soap and warm water is entirely satisfactory. Vaselin preparations are disagreeable, and if gloves are used are injurious to the rubber.

The left forefinger is introduced through the introitus with the hand in the position of pronation, pressure being exerted on the perineum, in order to avoid as much as possible contact with the urethra and clitoris. Passage through the introitus must be made with extreme gentleness and deliberation, for any quick or rough movement will cause the patient to contract the muscles of the abdomen and thighs. When the first phalanx of the forefinger has passed the introitus the hand is turned into the position of supination, which gives a spiral motion to the entering finger. The patient is now requested to relax as much as possible, and this is best accomplished by separating the legs widely. If the preliminary part of the examination has been ungentle or inconsiderate it is impossible to secure proper relaxation on account of the patient's fear of being hurt.

When the forefinger has reached the cervix, the external os is palpated and such conditions noted as the direction of the cervix, laceration, eversion, hypertrophy, cystic nodules, malignant infiltration, etc. Next, the finger feels along the anterior wall of the vagina, noting the anterior wall of the uterus, if it is in the forward position, and distinguishing the amount of angulation between cervix and body. The lateral and posterior fornices of the vagina are explored for the discovery of such abnormalities as vaginal scars, cysts, hypoplastic shortening, parametrial infiltration, or the protrusion toward the vagina from above of a tumor or pelvic abscess.

The right hand is now placed on the abdomen above the pubes and a bimanual examination made of the internal pelvic organs. The position of the uterus is first determined. This is best accomplished by placing the forefinger under the cervix and lifting the uterus toward the abdominal wall until the right hand can palpate the fundus, and note its size, consistency, and contour.

If by lifting the uterus toward the anterior abdominal wall the fundus cannot be felt by the right hand the uterus must be in some form of retroposition, the degree of which is then determined by forcing the left forefinger deeply into the posterior fornix of the vagina and palpating the posterior wall of the uterus. If the vagina is deep or the patient very fat, this last maneuver may be greatly facilitated if the examiner places his left elbow against his hip, by which firm and powerful pressure may be exerted without causing the patient pain.

Prolapse of the uterus is measured by placing the left forefinger on the cervix and requesting the patient to strain as in the act of defecation, when the amount of descensus may be noted. A more accurate method is by examination in the standing position.

When the position, size, and consistency of the uterus have been investigated, the sides of the pelvis are explored. The examining finger passes into the left posterior fornix of the vagina, pressing in deeply, while the right hand is shifted to the lower left quadrant of the patient's abdomen and pressed inward as if to meet the forefinger of the examining hand. In this way the adnexa are forced downward toward the left forefinger, which is thus enabled to palpate the lower hemisphere of the ovary. In a normal pelvis the adnexa cannot be felt by the external hand, while the finger in the vagina feels only one pole of the ovary unless the patient is very thin. A normal tube cannot ordinarily be palpated.

Bimanual examination of the adnexa reveals such pathologic conditions as prolapsed and cystic ovaries, ovarian tumors, tubal pregnancy, salpingitis, chronic pelvic inflammation with immobilizing adhesions, etc. Of great importance in examining the adnexa is the detection and proper interpretation of pain, and here again must be emphasized the necessity of distinguishing pain from some pathologic process and that which may be elicited by rough manipulation.

When the adnexa of the left side have been investigated attention is directed to the right side. When the examiner stands between the patient's knees he is

not in an advantageous position to explore the right side with the left forefinger. The left forefinger is, therefore, withdrawn from the vagina and the right forefinger inserted, the left hand now being used on the abdomen.

A very satisfactory method of exploring the right side without withdrawing the left forefinger is for the examiner to step to the left side of the patient, in which position it is easy to reach deeply into the right fornix of the vagina with the left forefinger.

When it is necessary to inspect the cervix and upper part of the vagina and to make local applications, a speculum must be used. This may be done with the patient on the back, in which case a bivalve speculum is usually employed.

A much more efficacious and convenient method is the classic one by which the patient is first placed in the Sims position, the success of the procedure depending chiefly on securing a proper position. It is necessary that the examining table be fitted with a Sims shelf extending from the left lower corner. The patient is made to lie on her left side with feet and legs supported by the shelf. The left hip should correspond as closely as possible to the lower right corner of the table. The right shoulder should be in contact with the right edge of the table, while the left arm rests along the other edge. In this way the patient is made to lie upon her breast.

The nurse stands at the patient's back, separating the lips of the vulva with the tips of the fingers, while the Sims speculum is being introduced by the examiner. When the speculum has been properly placed the nurse seizes it firmly with her right hand, still retracting the buttocks with the fingers of her left hand.

In order to secure a good exposure of the cervix and vault of the vagina it is necessary for the examiner to depress the anterior vaginal wall with a cotton stick or other convenient instrument. The Sims position is of especial advantage in inspecting the cervix, for removing specimens of tissue for microscopic examinations, for probing the cervical canal, and for the application of tampons and medicinal substances to the vaginal canal.

Occasionally the knee-chest position is useful for vaginal examinations. In this position two Sims' speculums may be employed, applied one to the posterior and one to the anterior wall of the vagina. The knee-chest position is uncomfortable and disagreeable to the patient, and as it has little advantage over the Sims position it need rarely be used.

### PELVIC EXAMINATION IN A PRIVATE HOUSE

Whenever possible gynecologic patients should be examined at the office, on a proper table with good light. When, however, it is necessary to make the examination at the patient's home the patient is instructed to be in bed. The abdominal part of the examination is made with the patient lying near the edge of the bed. For the bimanual part of the examination it is advantageous for

the patient to lie across the bed. In order to bring the pelvis into a good position for palpation of the organs the buttocks should extend over the edge of the bed, the feet being supported on two chairs or on the knees of the examiner, who is seated in a chair in front of the patient. If in this position the examination is unsatisfactory, it may be facilitated by having an assistant sit on the bed beside the patient and raise the thighs until they are in contact with the abdomen.

## ABDOMINAL OPERATIONS

**Preparation.**—In the performance of pelvic operations by the abdominal route the preparation of the bowels is of very great importance, for if they are distended and cannot easily be kept away from the surgical field the technical difficulties of the operation are greatly increased. Moreover, a thorough preparation of the bowels insures to a certain extent against troublesome postoperative gas formation. Surgeons differ considerably in the matter of catharsis, castor oil and calomel being the drugs most commonly used. Our method is as follows:

Unless the case is one of emergency the patient is required to enter the hospital on the second afternoon before the day set for the operation. This is done chiefly in order that the patient may pass through the somewhat depleting experience of catharsis at least twenty-four hours before the operation and have a night of unbroken rest immediately preceding her ordeal. Accordingly, on the afternoon of entrance into the hospital calomel in $\frac{1}{2}$-grain doses is given every half-hour until 4 grains have been administered. Calomel given in doses of this size passes rapidly through the intestinal tract, and only very rarely causes any of the disagreeable digestive and constitutional symptoms commonly ascribed to its use. If only a short time is available for the preparation of the bowels it is better to use castor oil.

Early the following morning the patient receives $\frac{1}{2}$ ounce of Epsom salts and in about one hour is given a high enema of soapsuds (1 pint). By this form of catharsis the patient undergoes a thorough cleansing of the bowel, but is not drastically purged.

After the enema the patient receives the preliminary skin preparation, which is carried out in the following way: Hospital patients are first given a warm tub bath. The abdomen and vulva are shaved and scrubbed with soap and water and alcohol. A vaginal douche of sterile water is given. Dry sterile pads are then applied. The patient is allowed to be up and about the rest of the day. Private patients are permitted to leave the hospital during the day and return at 5 o'clock. At that time the abdomen is washed with 70 per cent. alcohol, and then painted with tincture of iodin diluted with 70 per cent. alcohol (1 to 3). A fresh sterile pad is applied.

Early on the morning of the operation a cleansing suds enema and another vaginal douche of sterile water are given. When the patient has been anesthetized the abdomen is again painted with tincture of iodin (1 to 3).

The above preparation of the vulva and vagina is carried out as a routine measure in conjunction with the preparation for all gynecologic abdominal operations to provide for possible vaginal examination or drainage that may unexpectedly be required during the course of the operation.

If the abdominal operation is preceded by a vaginal operation the vulva and vagina receive an extra cleansing after the patient is anesthetized and immediately preceding the operation in the manner described below for the preparation of vaginal operations.

### Technical Detail in the Conduct of Abdominal Pelvic Operations

The patient should empty her bladder just before taking the anesthetic. It is advisable to anesthetize the patient on the operating table in a room adjoining the operating room. When the patient is fully anesthetized whatever vaginal preparation is necessary should be carried out before wheeling the patient into the operating room. If the operation is to be for a pelvic tumor it is best to catheterize the bladder in order to determine the position of the bladder, and to draw off any possible residual urine, the presence of which might interfere with the performance of the operation.

The patient is then placed in the Trendelenburg position and the table wheeled into the operating room, where a coat of iodin is applied to the abdomen and the patient properly draped with sterile coverings.

If the incision is to be a median one care should be exercised to make it exactly in the middle line, and not longer than is necessary for the proper performance of the intended operation. All small vessels in the abdominal fat should be caught at once with curved half-length clamps which fall out of the way when in place. If the aponeurosis is exposed without staining it with blood the linea alba is usually visible at once. The fascia is opened along this line, the scalpel entering the fatty space between the bellies of the rectus muscles. The muscles are separated with a few touches of the knife and the subperitoneal fat brought to view. The surgeon then places the forefingers of both hands in the wound and strips back the fat from the peritoneum, at the same time releasing the peritoneum from the under sheath of the rectus muscles for a short distance from the wound. The peritoneal layer thus thinned out is picked up with thumb forceps by the surgeon and the assistant and the peritoneum opened between the forceps by one delicate stroke of the knife. The opening thus made is enlarged by scissors until it will admit the hand of the operator, unless for some reason it is important that the wound be very small.

The first step is always to investigate the pelvis. If the pelvic condition is a serious one, such as a tumor or pelvic inflammation, attention is at once directed to that without further exploration of the abdominal cavity, this procedure being deferred until the end of the operation, and then carried out only if the

patient's condition warrants it or if sepsis has not been encountered during the pelvic operation.

If the pelvic condition is simple, requiring only a few minutes for its correction, as in the case of an uncomplicated retroversion, the appendix is sought for and removed. The left hand is then introduced into the abdominal cavity and all parts rapidly explored, especial attention being paid to the palpation of the gall-bladder and to abnormal adhesions in any part of the intestinal tract.

If the pelvic condition demands a serious operation the abdominal wound is enlarged according to the requirements of the case, a hysterectomy demanding an incision of the fascia well down to the symphysis. When the incision has been properly enlarged retractors are placed in the wound and the intestines packed away from the field of operation. This may be accomplished in the following way: The anesthetist has been previously instructed to have the patient deeply narcotized at this point of the operation, for if this is not done the manipulation of the intestines and the irritation of the gauze packing coming in contact with the peritoneum will stimulate contractions of the abdominal muscles with consequent delay of the operation. In order to remove the intestines from the operative field the surgeon first lifts with his left hand the coils of bowel which lie in the pelvis and pushes them toward the upper abdomen. With his right hand he pulls down the omentum so as to cover the intestines as much as possible. A "Western strip" wrung out in warm salt solution is then placed against the omentum and folded back and forth, forcing the intestinal contents into the upper abdominal cavity. A second strip is applied in like manner to tuck back any loops of intestine that may tend to escape. A dry gauze handkerchief is applied in front of the two strips. In this way the bowel is completely walled off from the field of operation in the pelvis. By first bringing down the omentum and then using moist gauze a minimum of trauma is done to the peritoneal surface of the intestines. If the bowel is involved in extensive pelvic adhesions these must be released before the walling-off gauze is applied. A strict count of the sponges used during the operation must be made by two persons and a written record kept by the operating room nurse.

Various devices are employed to prevent the possible leaving in of a *sponge in the abdominal cavity*. One of these consists of strips of braid sewed to the gauze sponges with leaden weights attached. Wakefield uses a very long strip of gauze which is fed from a pocket in the sterile abdominal sheet, in which it is folded and fastened.

Some operators protect the edges of the wound with napkins fastened to the skin with small towel clips. We have not found this necessary.

In the performance of pelvic operations it is important that the surgeon adopt a definite line of procedure for each operation, and follow the same technic step by step each time he does the operation. In this way he is enabled not only greatly to increase the speed with which he works, but to receive much

more efficient help from his assistants, who in a short time learn to anticipate his every want.

Success in pelvic surgery depends largely on the avoidance of loss of blood. Bleeding confuses the operation, causes delay, and is almost exclusively the cause of postoperative shock. It can best be prevented by religiously following the rule always to clamp or ligate a vessel before cutting it. The important vessels of the pelvis should be tied twice and a generous stump left beyond the tie to avoid later retraction.

The **suture material** used in pelvic surgery in our practice is, for the most part, chromicized catgut of various sizes. The ovarian and uterine vessels should be tied with No. 2 chromic gut. The ties are made twice with triple knots. Other vessels may be tied with No. 1 or No. 0, depending on their size and location. Small vessels in the bladder and intestinal walls are tied with No. 00 gut. Peritoneal surfaces are stitched with No. 0 or No. 00.

In the pelvis it should be kept in mind that knots and sutures are a prolific cause of postoperative adhesions. The surgeon must, therefore, continually exercise his ingenuity in avoiding as much as possible the exposure of the suture material to peritoneal surfaces.

The difficulties of pelvic surgery depend to a great extent on the inaccessibility of the field of operation. Thus, operations which under favorable conditions are comparatively simple, may present the most serious technical difficulties if the abdominal wall is very fat, or if the incision is too small, or if the abdominal muscles are in contraction from incomplete narcosis, or if the intestines are distended with gas.

One way in which operators often make trouble for themselves is by the collection of a great number of clamps, which obstruct the surgeon's view, prevent easy manipulation, and cause repeated tangles in the attempts to place ligatures. In a difficult pelvic operation, like that for cancer of the cervix, for example, it saves time to tie the vessels as they are caught and to keep the field free from clamps.

In releasing pelvic adhesions the surgeon must exercise precision and deliberation, most of the accidents that happen during this process being the result of haste or impatience. On the other hand, he must be sure that steady progress is being made, for time passes very rapidly when one is timidly puttering over some difficult adhesion.

When the pelvic operation has been finished the condition of the patient is noted, and if it is satisfactory and the operation has not already consumed too much time, the appendix is sought for and removed.

If no pus or other infecting condition has been encountered during the pelvic operation the walling-off gauze is extracted and the abdominal cavity explored, special search being made for possible gall-stones. The great omentum, if it is sufficiently ample, is now drawn down over the field of operation and the wound closed.

If pus has been encountered the patient is lowered into the horizontal position and the dry handkerchief gauze removed. The surgeon then changes his gloves and extracts the remaining strips. The intestines are not handled at all and no attempt is made to explore the abdominal cavity.

**Suture of Abdominal Wound.**—In sewing up the abdominal wound there are many methods, that employed by the author being as follows:

The ends of the wound in the peritoneum are seized with half-length clamps which draw the peritoneal folds well up from the rest of the wound. The edges of the peritoneum are sewed by a running suture of No. 1 chromic gut, beginning at the upper end. When the stitch has reached the lower end and is about to be tied tension on the peritoneum is released, and as much air as possible is allowed to escape from the abdominal cavity through the small opening in the peritoneum. Three or four sutures of No. 1 chromic gut are then introduced into the bellies of the recti muscles and tied sufficiently tight to approximate the muscles, but not tight enough to cause a paralysis or necrosis of the muscle-fibers. If the muscles are so separated that they cannot be approximated without due tension the skin wound is extended, and the operation for diastasis described on page 821 is performed.

When the sutures in the muscle bellies have been tied the corners of the fascia are caught by toothed half-length clamps. If the wound is a short one, without lateral tension, the fascia is closed by a single running suture of No. 1 chromic gut. If the wound is a long one or if there is considerable lateral tension, such as exists in fat abdominal walls, the upper half of the wound is closed with a No. 2 chromic gut suture which is tied at the center of the wound. A second suture of the same size is then introduced at the lower corner and the lower half of the wound is closed in like manner. All the small vessels of the fat previously caught in clamps are tied with No. 00 chromic gut.

The patient is now let down into the horizontal position. By this change it frequently happens that other small vessels in the fat or just under the skin begin to bleed. These are observed carefully, clamped, and tied. This maneuver is a rather important precaution against the postoperative bleeding and consequent hematoma of the wound. The skin and fat are approximated by several deeply placed sutures of silkworm gut. In order to secure exact coaptation of the skin edges a running stitch is used of No. 00 chromic gut and introduced with a very long Glover's needle held in the hand. The method of using a subcutaneous stitch for the skin coaptation we have discarded. A sterile dressing is then applied to the wound and fastened with a few adhesive straps. If the wound is very extensive, like that from a hernia operation, broad adhesive straps are applied overlapping each other and covering the lower part of the abdomen. Outside of this dressing is placed a many-tailed binder.

The deep silkworm-gut sutures are removed on the fifth or sixth day. The coaptation stitch of fine catgut absorbs for the most part during the final days of

convalescence, but it is usually necessary to pick from the wound a few remaining bits of the suture before the patient leaves the hospital.

### Postoperative Treatment of Abdominal Cases

In our hospital practice no morphin or other narcotic is given either before or after operation in the routine case. This rule we have not been able to carry out consistently in our private practice, in which many of the patients receive one or more doses of morphin during the first thirty-six hours following operation. It is a very significant fact, however, that the hospital patients are, on an average, at least a day ahead of the private patients during the first part of convalescence. This difference in favor of the hospital cases is, in considerable measure, undoubtedly due to the fact that drug narcosis is not employed. The personal element must in all surgical work be kept constantly in mind, and it cannot be denied that women in comfortable circumstances, whose training in life has been less rigorous than that of the less fortunate classes, are physically more sensitive to the first postoperative discomforts and more frequently require the relief afforded by drugs, which are given, as a rule, rather to prevent nervous exhaustion than as an alleviation of actual pain. When in the average case morphin is indicated it is our practice to administer $\frac{1}{6}$ grain subcutaneously several hours after the operation if the patient is beginning to get restless. During the first night, if it seems evident that the patient is becoming tired out either from pain or nervous from loss of sleep, another $\frac{1}{6}$ grain of morphin is allowed, combined with $\frac{1}{150}$ of hyoscin. Usually no further narcosis is necessary, except with very nervous or excitable patients.

The question of moving the bowels after an abdominal operation is an important and sometimes troublesome one. In the treatment of routine cases three methods may be employed, each one of which has its adherents. Either catharsis may be begun as soon as possible after the operation, or it may be started two or three days after, or the bowels may be left entirely alone until they move spontaneously.

In our experience the first method brings the best results as regards rapid and comfortable convalescence, and we have employed it almost universally in our hospital practice and in the majority of our private cases. In detail the method is as follows: About fifteen to eighteen hours after operation the patient is given 3 grains of calomel in $\frac{1}{2}$-grain doses at half-hour intervals. One hour after the last dose $\frac{1}{2}$ ounce of magnesium sulphate is administered. Four hours later a high soapsuds enema (1 pint) is given. In the great majority of cases the enema is followed by expulsion of gas and a colored watery movement of the bowels containing flakes of feces. If the enema is unsuccessful, it may be repeated in two or three hours with 1 dram of turpentine added to the soapsuds. With this treatment it is only rarely that the patient does not have a fairly comfortable second day. On the second night a cathartic is given, prefer-

ably in the form of a compound rhubarb pill (gr. v). On the following morning the patient receives another suds enema. This sequence is repeated during the rest of the convalescence—*i. e.*, cathartic pill at night and an enema the following morning—even if the bowels move spontaneously.

This method of early postoperative catharsis is less successful if it has been necessary to give morphin. When properly carried out the convalescence is remarkably rapid and only very exceptionally attended with the prolonged discomforts of gas, nausea, etc. By its use also the problem of nourishment is greatly simplified. During the first day after the operation sips of hot water are given at frequent intervals until 4 ounces can be retained. Dram doses of cold milk and lime-water in equal parts are then given. On the second day the patient has a cereal for breakfast, egg and toast at noon, and milk-toast at night. On the third day the diet is the same as on the second, while on the fourth day the patient is given the regular house diet.

The second method, that of delaying the catharsis until the second or third night, must in some cases be resorted to, but its results are far less satisfactory than those of the first method. If there is severe reaction from the operation, or if there is prolonged nausea from the anesthetic, or if the patient's stomach is extremely delicate, it is best not to attempt early catharsis. As a rule, patients of this kind begin to be troubled with gas on the second day. If it is accompanied by distention, various enemas must be tried to relieve the patient's distress. The formation of gas is likely to continue until satisfactory catharsis has been established, and it is, therefore, advisable to institute it as soon as the patient's stomach has become settled. The choice of a cathartic is then a difficult one, for under these circumstances the stomach is in very unstable equilibrium.

In our experience calomel is useful only when used soon after the operation, and is, therefore, not available in these cases. Castor oil is most efficacious, but is not always tolerated by the patient. Other cathartics, such as rhubarb, cascara, phenolphthalein, German powder, may be chosen. Pluto water in 2- and 3-ounce doses on the morning of the third day usually works well. It should be followed by an enema in a few hours if the bowels do not move spontaneously. Fabery's salts used in the same way we have found excellent.

The third method of treating the bowels in postoperative abdominal cases is to leave them alone until they move of themselves. We have not found this a particularly useful method for treating routine cases, for although it frequently works out successfully, in many instances gas formation takes place, and the patient falls into the second class described above, where catharsis and enemata become imperative. We are accustomed to adopt the method only in those cases in which active peristalsis might be dangerous, as after resection of the bowels, or when there is possibility of a general peritonitis. We also employ the method when the operation has been attended with profound shock. In these cases salt solution in small quantities (4 ounces) is introduced into the rectum

at frequent intervals until the patient's condition becomes satisfactory. Such patients usually have a spontaneous movement of the bowels in a few days.

**Length of Stay in Bed of Abdominal Cases.**—Patients who have undergone such routine gynecologic abdominal operations as uterine suspension, myomectomy, supravaginal hysterectomy, oöphorectomy, appendectomy, etc., and whose convalescence has been normal, remain in bed from seven to nine days, and can leave the hospital in from twelve to sixteen days.

Patients on whom operations for hernia or diastasis of the abdominal muscles have been performed should remain in bed from two to three weeks, according to the magnitude of the operation and the condition of the abdominal wall. Fat patients usually remain longer than thin because of the greater danger of postoperative hernia.

The provision for adequate *abdominal support* following all abdominal cases is of great importance, and should in no instance be neglected. For the average woman a well-fitting modern corset, reaching below the abdominal wound and exerting firm pressure over the lower abdominal region, is the best form of support. Very fat women require specially made corsets or abdominal belts. The best form of belt is made of webbing. The belt should be so constructed as to support and elevate the lower pendulous part of the abdomen. It should be worn continuously except at night.

## TECHNIC OF PLASTIC SURGERY

**Preparation.**—Twenty-four hours before the proposed operation the patient is given ½ ounce of Epsom salts. The vulva is shaved and scrubbed with soap and water. The vagina is thoroughly cleansed with green soap and sterile water. The vulva is dried and a dry sterile pad applied.

Four or five hours later the patient is given a high soapsuds enema. The sterile water vaginal douche is repeated, the vulva cleansed, and the dry sterile pad reapplied. If the patient is obliged to urinate or have a movement of the bowels, the external parts are irrigated and a fresh pad applied.

Early on the morning of the operation enemas are given until the water returns from the bowel clear. This is an important part of the preparation, for only by this means can the bowels be surely prevented from moving on the operating table and soiling the field of operation. Again the vagina is douched and a sterile pad reapplied.

When the operation is to be for complete tear of the perineum the preparation is the same except that castor oil is given as a cathartic instead of salts, the idea being that the movements from the oil are less irritating. The diet of these cases should be restricted on the day preceding the operation, especially as regards milk.

## Technical Details in the Performance of Plastic Operations

When the patient is fully anesthetized the lower leaf of the operating table is dropped and the patient placed with the buttocks just projecting over the edge of the table. The legs are drawn up with knees bent until the thighs rest on the patient's body. The legs are held in this position by a nurse assistant.

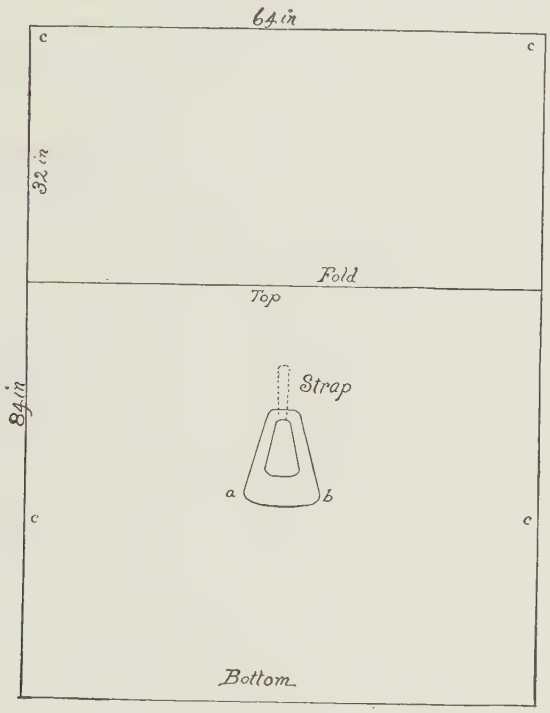


Fig. 535.—Directions for Making Ewin Perineal Sheet.

The sheet for vaginal operations performed in the dorsal position is made 84 inches long by 64 inches wide. One end is folded so that the corners marked *c* join *c* on each side, and the seams are closed, thus forming a pocket. The opening for the vulva should be 6 inches long, $2\frac{1}{2}$ inches wide at the bottom, $1\frac{3}{4}$ inches wide at the top. The lower facing, from *a* to *b*, is made double, to give a thicker covering over the anus. The edges of the opening are finished with a narrow binding. From the top of the opening, on the under side, fasten a strap, 10 inches long by 2 inches wide, in the manner indicated by the dotted line on the diagram.

To cover the patient, gather the top edge of the pocket in one hand, and cover the feet so that the toes of each foot come into the corner of the pocket, care being taken to locate the opening directly over the vulva. The strap on the under side must be pinned securely to the patient's night-dress. The sheet is tucked well under the buttocks, the long end being left to cover the pad.

This method of holding the perineal position is maintained throughout the operation, and is in our experience superior to the use of the posts and stirrups with which operating tables are usually equipped. With the patient in the perineal position, an assistant scrubs the vulva, vagina, anus, and adjacent parts of the thighs and buttocks with sterile soap and water, rinsing off the external parts with sterile water and alcohol.

A specially constructed perineal sheet is draped over the legs of the patient.

Numerous forms of sheets for this purpose have been devised. One of these which we have found very convenient is depicted in Fig. 535.

The surgeon's assistant stands at the patient's left, maintaining the position of the left leg by holding the knee under his right axilla. In this way the assistant has both his hands free for helping the surgeon.

In like manner a nurse stands, at the right of the patient, holding the right leg in the same way and acting as second assistant to the surgeon. At the surgeon's right is the suture and instrument table presided over by a nurse whose sole duty it is to place the necessary suture or instrument in the hand of the surgeon. This rather elaborate system of assistance is provided in order to secure as much speed as possible for operations which at best are rather tedious and time-consuming. Inasmuch as plastic operations must in the majority of cases be combined with a laparotomy, every effort should be made to shorten the time taken in their performance. This is best accomplished by carrying out the steps of a given operation in the same way each time, and by having a team of assistants who are thoroughly familiar with the technic of the surgeon.

**Suture Material.**—In most cases where sutures are required inside the vaginal canal catgut is employed. There is divided opinion among operators as to the comparative merits of plain or chromicized gut. Our experience has led us to discard the plain gut and to use the chromicized form exclusively. For approximating vaginal surfaces No. 1 is the most useful size and is employed in the operations of tracheloplasty, amputation of the cervix, anterior colpoplasty, and perineoplasty. In closing vaginal wounds the stitches *should always be interrupted.* Running stitches are used only in closing the deep layers in operations for fistula in which the tissues are split into separate planes, stitches of this kind being always buried. Sutures that are to be buried should not be larger than No. 0 or No. 00.

In fistula cases, both those of the bladder and rectum, it is best to unite the vaginal mucous membrane with interrupted silver wire, even in those cases in which the wounds are closed in different planes.

In sewing up wounds external to the vaginal orifice experience has taught us that silkworm gut is the best suture material, though many operators have discarded it in favor of catgut, on account of the necessity of removing the stitches. When silkworm gut is used the best method of protecting the ends is to clamp them in perforated shot, for by this means the stitches can be kept very clean and are prevented from causing discomfort by pricking the skin of the patient.

**Denudation.**—All plastic operations involve a certain amount of denudation of the epithelial surfaces. Denudation of the cervical mucous membrane in the operation of tracheloplasty is most easily done with a sharp scalpel. In the operations of anterior colpoplasty and perineoplasty the vaginal mucous membrane may be removed either by the "splitting" of a flap of membrane from the underlying tissue, or by removal of the membrane in narrow strips with Emmet's

scissors. We greatly prefer the latter technic. The flap-splitting method causes more bleeding, entails a greater loss of tissue, and even in the hands of an expert operator is associated with the danger of perforating the wall of the bladder or rectum. In some cases the plane of cleavage between vaginal mucous membrane and the underlying bladder or rectum is found easily enough and the layers can be rapidly and safely separated, but if the tissues are thinned out by tension or atrophy the separation may be difficult, bloody, and dangerous to the hollow organ beneath. We therefore recommend to the beginner the adoption of the classic technic of Emmet—*i. e.*, denudation of the tissues with scissors. With a little practice the membrane can be removed rapidly and entirely without danger.

In making a denudation it is important that the edges of the area should be smoothly cut. In order to accomplish this it is a good plan to pick up with tenacula the ends of the line to be cut. By drawing the tenacula in opposite directions the membrane is brought up into a sharp fold or ridge, which may be smoothly trimmed off with scissors (see Operation for Perineoplasty).

**Coaptation.**—The success of plastic surgery of the vagina depends to a great extent on the ability of the operator to secure accurate coaptation of the wound edges without undue tension. In order to accomplish this the greatest care should be taken in making the denudation, that the wound edges when coaptated shall fit perfectly without wrinkling and puckering of the tissues. This requires a good eye for symmetry and proportion on the part of the operator.

Wounds in which the edges have been skilfully approximated heal rapidly by first intention, whereas wounds in which the coaptation is clumsy and ragged invariably heal by granulation and the formation of permanent scar tissue. As has been emphasized in the section on Plastic Surgery, many of the unpleasant after-results from operations on the vagina are the result of the contraction of old cicatrices.

### After-care of Plastic Cases

The patient is encouraged to urinate within a few hours after operation. When an operation for cystocele has been performed it is important that the bladder should not become distended. For the first two days it should not be allowed to accumulate over 5 ounces of urine. Fortunately, most patients who have had cystocele operations are soon able to urinate voluntarily. They should be made to empty the bladder every four hours for the first two days and at night should be wakened for this purpose. If the patient is unable to pass her water voluntarily she must be catheterized at regular intervals. If the catheterization is carried out in the following manner (described also on page 279) there is practically no danger of causing a cystitis: A sterile glass catheter is attached to a fountain syringe supplied with sterile water. The sterile water at low tension is allowed to flow through the catheter and cleanse the vestibule and surrounding parts of the vulva. The catheter is then introduced into the

meatus while the water is still flowing. When the end of the catheter reaches the middle of the urethra the water from the fountain syringe is shut off and the rubber tube of the syringe detached from the catheter. The catheter is then passed into the bladder and the urine withdrawn.

When a patient has had an operation for vesicovaginal fistula it is of still greater moment that the bladder be not distended with urine. These patients for the first four days should void every four hours, or if voluntary urination is impossible they should be catheterized. After the second day the intervals between voiding may be somewhat longer. Most patients who have had operations for vesical fistulas are able soon to urinate voluntarily. It is a good plan, however, to catheterize such patients at least once a day, for many of them retain a certain amount of residual urine.

In none of our cases, either for cystocele or for vesical fistula, do we employ *constant drainage.*

**Catharsis.**—On the morning following a plastic operation the patient is given $\frac{1}{2}$ ounce of Epsom salts, and in the course of three or four hours a low soapsuds enema, except after operations involving the sphincter or rectum. At night the patient receives a compound rhubarb pill (gr. v) and on the following morning an enema, whether she has a voluntary movement or not. The cathartic pill at night and enema in the morning are repeated daily as a routine during the rest of the patient's stay in the hospital. In some cases, especially in private practice where there is great objection to the taking of enemas, this treatment must be modified somewhat by adding other cathartics. The results, however, are not as satisfactory as when the above routine procedure is carried out.

After operations for *complete tear* we are not accustomed to move the bowels for nine days. Patients who have had this operation require the most unremitting care and expert nursing. Every effort is made to prevent a movement of the bowels, and for this reason the patient is kept on a restricted liquid diet without milk, though oysters, eggs, and jellies of various kinds are occasionally permitted. If there is active peristalsis the patient may be given 15 drops of tincture of opium.

The bowels are moved on the ninth day by giving 1 ounce of castor oil followed in a few hours by a low oil enema (cottonseed oil, 4 ounces). After the first movement the bowels are treated in the same manner as in other plastic cases.

**Care of the Stitches.**—Much of the success of a plastic operation depends on the care of the stitches, for any neglect of them is sure to be followed by sepsis. The first duty of the nurse is to irrigate the stitches after each urination or defecation with sterile water and to apply each time a fresh sterile pad to the parts.

In the treatment of the vaginal stitches two methods are in vogue: one by which the stitches are let alone and the other by which they receive frequent

cleansing douches. These may be called the dry and wet methods. We are very much in favor of the wet method, which is as follows:

On the day following the operation vaginal douches of sterile water are given, two each day. This is continued throughout the convalescence. If at the time of leaving the hospital there is any leukorrheal discharge present, as there sometimes is as a result of irritation from stitches not yet absorbed, the patient is advised to take a douche each day or every other day for a week or two after reaching home. If silkworm-gut stitches have been used in sewing up the external part of the perineum, they should be removed on the ninth day, after which the patient is allowed to sit up. Her usual stay in the hospital is from twelve to fifteen days.

By treating the wounds in the above way sepsis is very unusual in the ordinary plastic cases. Operations for complete tear, involving as they do the anus and rectum, are more frequently complicated by sepsis on account of the impossibility of keeping the wounds perfectly clean. The sepsis usually takes the form of a small localized stitch abscess which discharges and then heals rapidly, occasionally causing a minute temporary fistula. It rarely affects the ultimate functional result of the operation.

Stitch abscesses during the first stage are best treated by hot applications of sterile salt solution, changed very frequently. Treated in this way the infections remain localized and often disappear without suppuration. If suppuration occurs the hot applications are continued until the pus discharges spontaneously. Once or twice each day the small abscess is forcibly evacuated through the small opening by pressure with the fingers. With careful attention and cleanliness the wound soon heals without injuring the result of the operation.

Silver wire stitches used in operations for fistula are treated as other vaginal stitches. They are not removed for two or three weeks.

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